The Welding Engineer

Edited by L. B. Mackenzie

$3.00 per year in U. S. | Reg. U. S. Pat. Office | $4.00 per year abroad

Vol. 8 | 608 S. Dearborn St. | OCTOBER, 1923 | Chicago, Ill. | No. 10

AIRCO DAVIS APPARATUS

ANYTHING AND EVERYTHING
FOR OXYACETYLENE WELDING AND CUTTING

Public faith in a product is a reflection of faithful performance. Thus, consistently, have Airco Oxygen and Airco Acetylene built up good-will.

AIR REDUCTION SALES COMPANY

Manufacturer of Airco Oxygen—Airco Acetylene—Airco-Davis-Bournonville Welding and Cutting Apparatus and Supplies, Acetylene Generators, and Specially Designed Machines for Automatic Welding and Cutting—Nitrogen, Argon and other Airco Atmospheric Gas Products

Controls the manufacture and sale of National Carbide

Home Office: 342 Madison Avenue, New York, N. Y.

Airco District Offices, Plants and Distributing Stations conveniently located throughout the country.

Air Reduction Sales Co. maintains its own Apparatus Repair Shops in Airco District Office cities.

"Airco Oxygen and Acetylene Service is Good Service."

Published monthly by the Welding Engineer Publishing Co. Entered as second class matter Jan. 20, 1916, at the Post Office at Chicago, Ill. Under the Act of March 3, 1879.

Pipe-line Welding is modern efficiency's answer to problems of installation, leakage and expensive upkeep

140 Miles of Oil Pipe —and All One-Piece!

Another example of the splendid economy and efficiency of long distance pipe-line welding. Over 18,500 welds and, as the superintendent said, "upon testing under 800 lbs. cold water pressure there developed but four defective welds, which speak volumes for the equipment."

The equipment was Oxweld.

In addition their engineers figured they had saved nearly 35% over the per mile *installation cost* of a screwed-coupling line!

Small wonder many big companies have now standardized oxy-acetylene welded joints. The welded joint is permanent and as strong or stronger than the pipe material itself; no couplings, therefore no leakage—one unbroken length of pipe; costs less to install and maintain; time and labor saved; and more flexible construction as absence of couplings permits following easier the contour of the terrain.

Oxweld Resident Engineers in over fifty cities are ready to work on your problems. Send today for book on pipe welding.

OXWELD ACETYLENE COMPANY
Newark, N. J. Chicago San Francisco

Oxweld

WELDING AND CUTTING APPARATUS

World's Largest Manufacturers of Welding and Cutting Equipment

Welding and Cutting Torches

Unequalled in construction
Unsurpassed in performance

Mixture (Continued)

The WELDING MIXTURE must be thorough, correct in ratio of oxygen to acetylene and constant in these qualities in operation.

Consider as an example the cutting torch in which a jet of pure oxygen is projected through the central portion of a high temperature flame at a velocity of one thousand feet per second. No appreciable mixing takes place due to lack of TIME and TURBULENCE.

PUROX torches standard equipped allow one hundredth part of a second or more for mixing and by means of repeated expansion and contraction of the diameter of the gas stream cause a turbulence that brings the gases together so intimately that perfect combustion is obtained and no oxygen wasted.

The MIXED gas only is subjected to temperatures above normal and therefore the RATIO of the MIXTURE is not varied by unequal expansion of the gases or of the orifices through which they pass.

Restriction of gas flow, due to heating of the tips or accidental obstruction, causes a negligible change in gas ratio in PUROX torches.

That steel is rapidly attacked by oxygen is conclusively demonstrated in cutting. Oxygen POORLY MIXED is not consumed by the acetylene and acts in the same way on the steel of the weld, causing oxide inclusions that weaken it.

We guarantee PUROX torches to maintain a ratio of 1.03 or less volumes of pure oxygen per volume of acetylene in your plant, on your pipe line, or under any of the usual conditions of use.

PUROX COMPANY

2305 E. 52nd St.
Los Angeles, Cal.

3030 Huron St.
Denver, Colo.

1135 Third St.
Oakland Calif.

71 Steuart Street
San Francisco, Calif.

2020 East 22nd St.
Cleveland, Ohio

362 Pierpont Ave.
Salt Lake City, Utah

14 East 13th St.
Kansas City, Mo.

2920 First Ave. So.
Seattle, Wash.

620 East Hancock St.
Detroit, Mich.

1200 Sheffield St.,
N. S. Pittsburgh, Pa.

Representatives throughout the
United States, Canada and Mexico.

WELDING
PUROX
CUTTING

Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

ACETYLENE GENERATORS
Air Reduction Sales Co.
Bastian-Blessing Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
Imperial Brass Mfg. Co.
Alexander Milburn Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Welding Metals Mfg. Co.

ALUMINUM FILLER RODS
Air Reduction Sales Co.
Bierman-Everett Foundry Co.
Burdett Oxygen Co.
Carbic Mfg. Co.
Wm. Cramp & Sons
Davis-Bournonville Co.
Electric Arc Cutting & Welding Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Hauck Mfg. Co.
Imperial Brass Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Superior Oxy-Acetylene Mach. Co
Torchweld Equipment Co.
United States Welding Co.
Welding Metals Mfg. Co.

ALUMINUM FLUX
Air Reduction Sales Co.
Bierman-Everett Foundry Co.
Burdett Oxygen Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Hauck Mfg. Co.
Hoskins Process Development Co.
Imperial Brass Co.
Modern Engineering Co.
Morey Flux & Chemical Co.
Oxweld Acetylene Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.
Welding Metals Mfg. Co.

ALUMINUM SOLDER
Air Reduction Sales Co.
Burdett Oxygen Co.
Liberty Welding & Mfg. Co.
Purox Co.
Welding Metals Mfg. Co.

ANNEALING FURNACES
Buffalo Dental Mfg. Co.
General Electric Co.

APRONS (Asbestos)
Chicago Eye Shield Co.
Electric Arc Cutting & Welding Co.
Purox Co.

ASBESTOS GLOVES
Air Reduction Sales Co.
Burdett Oxygen Co.
Chicago Eye Shield Co.
Davis-Bournonville Co.
Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Purox Co.
Universal Oxygen Co.

ASBESTOS SHEET PAPER
Air Reduction Sales Co.
Burdett Oxygen Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Purox Co.
Sall Mountain Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Welding Metals Mfg. Co.

BLOW TORCHES (Acetylene)
See "Torches"

BOOKS (Relating to Welding)
The Welding Engineer
Electric Arc Cutting & Welding Co.

Rochester Welding Works

We not only do welding, but supervise the design and installation of oxy-acetylene welding plants; report on welding material and methods; make tests on welding apparatus for efficiency and economy.

Nine years' experience.

Rochester Welding Works
349 Orchard St., Rochester, N.Y

BRASS AND BRONZE FLUX
Air Reduction Sales Co.
Bierman-Everett Foundry Co.
Burdett Oxygen Co.
Carbic Mfg. Co.
Hauck Mfg. Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
United States Welding Co.
Oxweld Acetylene Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
Welding Metals Mfg. Co.

BRASS SPELTER WIRE
Air Reduction Sales Co.
Bierman-Everett Foundry Co.
Burdett Oxygen Co.
Davis-Bournonville Co.
Oxweld Acetylene Co.
Purox Co.
Torchweld Equipment Co.

BRAZING OUTFITS
Bastian-Blessing Co.
Buffalo Dental Mfg. Co.
Davis-Bournonville Co.
Harris Caloric Co.
Hauck Mfg. Co.
Imperial Brass Mfg. Co.
Alexander Milburn Co.
Oxweld Acetylene Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
Welding Metals Mfg. Co.

ACETYLENE (Compressed in Cylinders)
Air Reduction Sales Co.
Commercial Acetylene Supply Co.
Prest-O-Lite Co.

BRONZE FILLER RODS
Air Reduction Sales Co.
Bierman-Everett Foundry Co.
Carbic Mfg. Co.
Central Steel & Wire Co.
Wm. Cramp & Sons
Davis-Bournonville Co.
Electric Arc Cutting & Welding Co.
Burdett Oxygen Co.
Hauck Mfg. Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.

REAMERS, PORTABLE ELECTRIC
N. A. Strand & Co.
Wodack Electric Tool Corporation

CABLE (For Leads)
Electric Arc Cutting & Welding Co.
General Electric Co.
Quasi-Arc Weldtrode Co.
Transportation Engineering Corp.
Wilson Welder & Metals Co.

CARBIDE (Calcium)
Air Reduction Sales Co.
American Carbolite Sales Co.
Carbic Mfg. Co.
Gas Tank Recharging Co.
Shawinigan Products Corp.
Standard Carbide Sales Co.
Union Carbide Sales Co.

CARBIDE (Compressed in Cakes)
Carbic Mfg. Co.

CARBON (Blocks, Paste, Etc.)
Air Reduction Sales Co.
National Carbon Co.
U. S. Welding Co.
Electric Arc Cutting & Welding Co.

CARBON REMOVING TORCHES
See "Torches"

CAST IRON FILLER RODS AND FLUX
Air Reduction Sales Co.
Burdett Oxygen Co.
Bierman-Everett Fdy. Co.
Carbic Mfg. Co.
Central Steel & Wire Co.
Chicago Steel & Wire Co.
Wm. Cramp & Sons
Davis-Bournonville Co.
Electric Arc Welding & Cutting Co.
Hauck Mfg. Co.
International Oxygen Co.
Modern Engineering Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Purox Co.
Imperial Brass Mfg. Co.
Page Steel & Wire Co.
John A. Roebling's Sons Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
Transportation Engineering Corp.
United States Welding Co.
Welding Metals Mfg. Co.

COPPER FLUX
Air Reduction Sales Co.
Bierman-Everett Foundry Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
Oxweld Acetylene Co.
Purox Co.
Imperial Brass Mfg. Co.

CUTTING RODS (Elec. Arc)
Electric Arc Cutting & Welding Co.

CYLINDERS
Wm. Wharton, Jr., & Co.

DRILLS, PORTABLE ELECTRIC
N. E. Strand & Co.
Wodack Electric Tool Corporation

ELECTRIC ARC WELDING OUTFITS
Electric Arc Welding & Cutting Co.
General Electric Co.

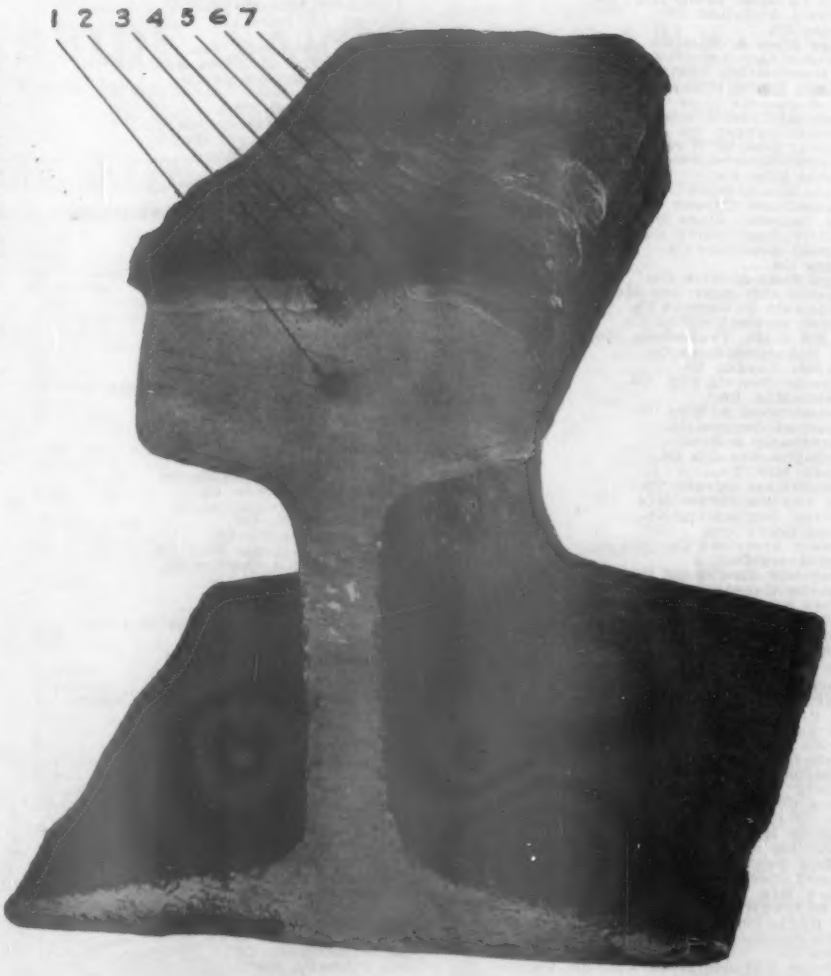
For Welding High Carbon Steel

PAGE HIGH CARBON GAS WELDING RODS

Gas welding of High Carbon Steel Parts can best be accomplished by the use of Page High Carbon Gas Welding Rods. The data presented herewith is typical of results secured with Page High Carbon Gas Welding Rods, and indicates qualities more than equal to the original metal.

Conform in all respects to A. W. S. specifications.

Look for red tag and red-colored ends.



Hardness Analysis

(Scleroscope)

1	(Original Metal)	30
2		31
3		31
4		32
5		33
6		35
7		37

PAGE STEEL AND WIRE COMPANY

An Associate Company of the American Chain Company, Inc.

BRIDGEPORT, CONN.

DISTRICT SALES OFFICES:

Chicago New York Pittsburgh San Francisco

ALSO MANUFACTURERS OF:

WELDING WIRE—Page-Armco Gas Welding Rods and Electrodes.
RODS—Armco Ingot Iron and Special Analysis Steels.
WIRE—Plain and Galvanized—Telephone, Telegraph, Bond and Strand.
FENCE—Woven Wire for Farm and Railway Right of Way, Wire Link Protection for Industrial Plants, Lawns, Schools and Estates, and Factory Partitions.

Quasi-Arc Weldrode Co.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

ELECTRODE HOLDERS
Electric Arc Welding & Cutting Co.
General Electric Co.
Quasi-Arc Weldtrode Co.
Transportation Engineering Corp.
Wilson Welder & Metals Co.

ELECTROLYTIC OXYGEN AND HYDROGEN GENERATING EQUIPMENT
Burdett Oxygen Co.
International Oxygen Co.

FILLER RODS (Swedish Iron)
Air Reduction Sales Co.
Bierman-Everett Fdy. Co.
Burdett Oxygen Co.
Carbic Mfg. Co.
Central Steel & Wire Co.
Chicago Steel & Wire Co.
Wm. Cramp & Sons
Electric Arc Cutting & Welding Co.
Davis-Bournonville Co.
Hauck Mfg. Co.
Modern Engineering Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Purox Co.
Page Steel & Wire Co.
Superior Oxy-Acetylene Machine Co.
Transportation Engineering Corp.

FILLER RODS (Tobin Bronze)
Air Reduction Sales Co.
Bierman-Everett Foundry Co.
Burdett Oxygen Co.
Central Steel & Wire Co.
Bierman-Everett Fdy. Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Page Steel & Wire Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.

FILLER RODS (Vanadium Steel)
Air Reduction Sales Co.
Burdett Oxygen Co.
Bierman-Everett Fdy. Co.
Carbic Mfg. Co.
Central Steel & Wire Co.
Universal Oxygen Co.
Wm. Cramp & Sons
Davis-Bournonville Co.
Hauck Mfg. Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
Purox Co.
Oxweld Acetylene Co.
Reid-Avery Co.
Torchweld Equipment Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.

FIREPROOF PLASTIC
National Carbon Co.
U. S. Welding Co.

FLUE WELDERS (Electric)
General Electric Co.

FLUXES
Air Reduction Sales Co.
Bierman-Everett Foundry Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
Imperial Brass Mfg. Co.
Modern Engineering Co.
Purox Co.
Smith's Inventions, Inc.
Welding Metals Mfg. Co.

FURNACES (Annealing)
Buffalo Dental Mfg. Co.
General Electric Co.
Hauck Mfg. Co.

GAS BURNERS (Preheating)
Air Reduction Sales Co.
Davis-Bournonville Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.

GAUGES
U. S. Gauge Co.

GENERATORS (Oxygen or Hydrogen)
Burdett Oxygen Co.
International Oxygen Co.

GLOVES (Welders Asbestos)
Air Reduction Sales Co.
Burdett Oxygen Co.
Carbic Mfg. Co.
Chicago Eye Shield Co.
Davis-Bournonville Co.
Electric Arc Cutting & Welding Co.
International Oxygen Co.
Imperial Brass Mfg. Co.
Purox Co.
Torchweld Equipment Co.
Welding Metals Mfg. Co.

GOGGLES
Air Reduction Sales Co.
Bastian-Blessing Co.
Carbic Mfg. Co.
Chicago Eye Shield Co.
Davis-Bournonville Co.
Imperial Brass Mfg. Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Quasi-Arc Weldtrode Co.
Transportation Engineering Corp.
Welding Metals Mfg. Co.

GRINDERS, PORTABLE ELECTRIC
N. A. Strand Co.
Transportation Engineering Corp.
Wedack Electrical Tool Corporation.

HARDENING FURNACES
Buffalo Dental Mfg. Co.
General Electric Co.
Hauck Mfg. Co.

HOSE (Oxygen and Acetylene)
Air Reduction Sales Co.
Bastian-Blessing Co.
Burdett Oxygen Co.
Buffalo Dental Mfg. Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
International Oxygen Co.
Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.

HOSE UNIONS
Air Reduction Sales Co.
Bastian-Blessing Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
Hauck Mfg. Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Alexander Milburn Co.
Oxweld Acetylene Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.

HYDROGEN
Burdett Oxygen Co.
Gas Products Association
International Oxygen Co.

HYDROGEN PLANTS
Burdett Oxygen Co.
International Oxygen Co.
Universal Oxygen Co.

KEROSENE PREHEATING TORCHES
Air Reduction Sales Co.
Bastian-Blessing Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
Hauck Mfg. Co.
The Imperial Brass Mfg. Co.
Imperial Brass Mfg. Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Welding Metals Mfg. Co.

NEEDLE VALVES
Air Reduction Sales Co.
Bastian-Blessing Co.
Burdett Oxygen Co.
The Bastian-Blessing Co.
Buffalo Dental Mfg Co.
Davis-Bournonville Co.
Harris Calorific Co.
Federal Brass Works.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Alexander Milburn Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
Welding Metals Mfg. Co.

NITROGEN
Air Reduction Sales Co.
American Oxygen Machinery Corp.
Linde Air Products Co.

OIL BURNERS (Preheating)
Air Reduction Sales Co.
Bastian-Blessing Co.
Carbic Mfg. Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.

OXY-ACETYLENE CUTTING MACHINES
Davis-Bournonville Co.
Air Reduction Sales Co.

OXYGEN (Compressed in Cylinders)
American Oxygen Machinery Corp.
Air Reduction Sales Co.
Burdett Oxygen Co.
Gas Products Ass'n.
International Oxygen Co.
The Linde Air Products Co.
Purox Co.

OXYGEN AND HYDROGEN GENERATING EQUIPMENT
Burdett Oxygen Co.
Gas Products Assn.
International Oxygen Co.
Universal Oxygen Co.

OXYGEN PLANTS (Liquefaction)
H. G. Amling.
M. Keith Dunham

PREHEATING FURNACES
Buffalo Dental Mfg. Co.
Hauck Mfg. Co.
Imperial Brass Mfg. Co.
Modern Engineering Co.
Superior Oxy-Acetylene Machine Co.

PRESSURE GAUGES
Air Reduction Sales Co.
Bastian & Blessing Co.
Burdett Oxygen Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
Harris Calorific Co.
Hauck Mfg. Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
Alexander Milburn Co.
Modern Engineering Co.
Purox Co.
Oxweld Acetylene Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
U. S. Gauge Co.
Torchweld Equipment Co.
United States Welding Co.
Welding Metals Mfg. Co.

REGULATING VALVES (Acetylene)
Air Reduction Sales Co.
The Bastian-Blessing Co.
Burdett Oxygen Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
Federal Brass Works
Harris Calorific Co.
Hauck Mfg. Co.
International Oxygen Co.
The Imperial Brass Mfg. Co
K-G Welding & Cutting Co.
Alexander Milburn Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.
Welding Metals Mfg. Co.

BUFFERS, PORTABLE ELECTRIC
N. A. Strand & Co.
Wodack Electric Tool Corporation

REGULATING VALVES (Hydrogen)
The Bastian-Blessing Co.
Burdett Oxygen Co.
Federal Brass Works
Harris Calorific Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
Alexander Milburn Co.
Modern Engineering Co.
K-G Welding & Cutting Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.
Smith's Inventions, Inc.
Torchweld Equipment Co.

REGULATING VALVES (Oxygen)
Air Reduction Sales Co.
The Bastian-Blessing Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
Federal Brass Works
Harris Calorific Co.
Imperial Brass Mfg. Co.
Alexander Milburn Co.
Oxweld Acetylene Co.
Purox Co.
Smith's Inventions, Inc.

SAND BLAST
Transportation Engineering Corp.

SEAM WELDERS (Electric)
General Electric Co.

SOLDERS
Liberty Welding Co.
Welding Metals Mfg. Co.

TORCHES (Oxy-Acetylene Welding and Cutting)
Air Reduction Sales Co.
The Bastian-Blessing Co.
Carbic Mfg. Co.
Burdett Oxygen Co.
Davis-Bournonville Co.
C. H. Dockson Co.
Federal Brass Works
Harris Calorific Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Metals Welding Co.
Alexander Milburn Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.
Welding Metals Mfg. Co.

TORCHES (Oxy-Hydrogen Welding and Cutting)
The Bastian-Blessing Co.

Texas Headquarters for Welding and Cutting. The Best Equipped Plant in the State.

Southern Welding & Machine Co.
212-14 College Street
San Antonio, Texas

Burdett Oxygen Co.
Davis-Bournonville Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Alexander Milburn Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.
Smith's Inventions, Inc.
Torchweld Equipment Co.
United States Welding Co.
Welding Metals Mfg. Co.

TANK CONNECTIONS (Oxygen and Acetylene Adaptors)
Air Reduction Sales Co.
Bastian-Blessing Co.
Davis-Bournonville Co.
International Oxygen Co.
Alexander Milburn Co.
Oxweld Acetylene Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
The Imperial Brass Mfg. Co.
Torchweld Equipment Co.

TORCHES (Gasoline and Kerosene Preheating)
Air Reduction Sales Co.
Bastian-Blessing Co.
Buffalo Dental Mfg. Co.
Carbic Mfg. Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.

UNION CARBIDE

WORLD'S BEST QUALITY—HIGHEST GAS YIELD

ALWAYS PACKED IN BLUE AND GRAY DRUMS

Large stocks of Union Carbide in all regular commercial sizes are carried at each of Union Carbide Sales Company's Warehouses listed below.

Requests for information and special correspondence should be addressed to our New York, Chicago or San Francisco offices.

Generator Sizes of Union Carbide

Packed in 100 Pound Drums

3½ in. x 2	in.	(Lump)
2 in. x ½	in.	(Egg)
1¼ in. x ⅜	in.	(Nut)
¼ in. x 1/12	in.	(Quarter)

For Oxy-Acetylene Welding and Cutting Plants, Acetylene House Lighting and Cooking Plants, Contractors' Torches and Flare Lights, and numerous other pieces of Acetylene generating apparatus designed for the use of one of these sizes of Carbide.

UNION CARBIDE SALES COMPANY

Peoples Gas Building
Chicago, Ill.

Carbide and Carbon Building
30 East 42nd St.
New York

Balfour Building
California and Sansome Sts.,
San Francisco, Calif.

UNION CARBIDE SALES COMPANY'S WAREHOUSES

Shipments Always Made On Day Orders Are Received

ALABAMA
Birmingham.....12 So. 20th St.
Mobile.....16 S. Commerce St.
Montgomery.....15 Washington Ave.

ARIZONA
Phoenix.....42 S. Central Ave.

ARKANSAS
Ft. Smith.....109 So. 9th Street
Little Rock.....1400 E. 6th St.

CALIFORNIA
Fresno.....932 8th St.
Los Angeles.....639 Gibbon Street
Oakland (See San Francisco).
Sacramento.....217 O St.
San Diego.....Seventh and J Sts.
San Francisco, California and Sansome St.

COLORADO
Denver.....Nineteenth and Wazee Sts.

CONNECTICUT
Hartford.....409 Windsor St.

DISTRICT OF COLUMBIA
Washington .....Maryland Ave. and 9th St., S. W.

FLORIDA
Jacksonville, 12 Cedar St., P. O. Box 124
Tampa.....1702 Grand Central Ave.

GEORGIA
Atlanta.....Haynes and Rhodes Sts. P. O. Box 1594
Savannah, Ogeechee Canal and Broughton St. P. O. Box 78.

ILLINOIS
Chicago.....122 So. Michigan Boulevard
Danville.....511 Oak St.
Decatur.....133 W. William St.
East St. Louis.....700 Broadway
Eldorado.....856 So. 4th St.
Harrisburg.....631 No. Webster St.
Marion..315 S. Granite St., P. O. Box 747
Monmouth.....61½ Public Square
Peoria.....100-110 Edmund St.
Quincy.....313 Delaware St.
Springfield.....1801 Washington St.
Streator.....501 E. Hickory St

INDIANA
Clinton.....102 E. Mulberry St.
Evansville.....1401 Illinois St.
Fort Wayne.....2206 Broadway
Indianapolis....601-617 Kentucky Avenue
Terre Haute.....714 North 5th Street

IOWA
Davenport.....113 Harrison St.
Des Moines.....Third and Elm Sts.
Dubuque.....8th and Washington Sts.
Fort Dodge.....Central Ave. at 16th St.
Ottumwa.....207-9-11 S. Washington St.
Sioux City..926 Fourth St., P. O. Box 598
Waterloo.....1209 East Fourth St.

KANSAS
Pittsburgh.....524 N. Broadway
Salina.....154 N. Fifth St.
Wichita....Douglas and Sycamore Aves. P. O. Box 951

KENTUCKY
Allen .....Beaver Creek
Central City.....306 Broad St.
Louisville.....126 E. Main St.
Middlesboro.....1701 Cumberland Ave.

LOUISIANA
New Orleans.....4124 Toulouse St.
Shreveport.....415 Market St.

MAINE
Portland.....11 Exchange St.

MARYLAND
Baltimore.....19 E. Lombard St.
Cumberland .....18 N. George St., P. O. Box 172
Salisbury.....406 Main St.

MASSACHUSETTS
Indian Orchard .....
Worcester..... 15 Federal St.

MICHIGAN
Detroit.....5785 Hamilton Ave.
Grand Rapids..500 Shawmut Ave., N. W.
Hancock.....First Nat'l Bank Bldg.
Iron Mountain.....513 Stephenson Ave.
Iron River.321 Carnegie Ave., Box No. 357
Ironwood .....
Ishpeming.....412 E. Division St.
Jackson.....172 South Water St.
Lansing.....617 E. Shiawasee St.
Muskegon.....308 W. Western Ave.
Saginaw.....1530 N. Michigan Ave.
Sault Ste. Marie.....

MINNESOTA
Minneapolis.....334 N. First St.
Virginia.....413 Chestnut St.

MISSISSIPPI
Vicksburg.....1701-3 Levee St.

MISSOURI
Kansas City.....1422 St. Louis Ave.
St. Joseph.....920 South Sixth St.
St. Louis.....(See East St. Louis, Ill.)

NEBRASKA
Omaha.....1007-9-11 Jones St.
Union Sta. P. O.

NEW JERSEY
Camden.....Front and Division Sts.
Newark.....251 Ridgewood Ave.

NEW YORK
Albany.....108 Third Ave.
Binghamton.....83 Prospect Ave.
Brooklyn.....382 Metropolitan Ave.
Buffalo.....1336 Genesee St.
Geneva.....Exchange St. & R. R. Place
Hurleyville .....
Jamaica.....11 New York Ave.
Kingston.....O'Neil St., Near Broadway
Niagara Falls .....
Poughkeepsie.....Smith St. and N. Y., N. H. & H. R. R. Tracks
Utica..... 135 Hotel St.
Watertown..... 488 Court St.
Whitehall..... 22-23 Main St.

NORTH CAROLINA
Charlotte .....
Palmer St. & P. & N. R. R., P. O. Box 777.

Raleigh .....
.....204 W. Hargett St., P. O. Box 149
Wilmington .....
Surry St., between Castle & Queen Sts.
Wilson..700 Goldsboro St., P. O. Box 272

NORTH DAKOTA
Fargo.....Fifth St. and Second Ave. N.

OHIO
Athens.....Factory and Moore Sts.
Canton.....618 Mulberry Road, S. E.
Cincinnati.....67 Plum St.
Cleveland.....631 Hannah Bldg. Annex
Columbus.....310 Dublin Ave.
Dayton.....812-828 First Street
Gallipolis.....700 First Avenue
Lima.....338 East High St.
Mansfield.....40 West Third St.
Steubenville.....324-343 N. Seventh St.
Toledo.....414 S. Erie St.
Youngstown.....Jones and Brittain Sts.
Zanesville.....Main and 2nd Sts.

OKLAHOMA
McAlester.....8 N. Main St.
Oklahoma City.....4 West Park Place
Tulsa.....1-11 Boulder St., North

OREGON
Portland.....15th and Hoyt Sts.

PENNSYLVANIA
Beaver..... 231 Third St.
DuBois....Weber Ave. and Franklin St.
East Greensburg..Clark and George Sts.
Erie..... 1426 Chestnut St.
Harrisburg.....25 S. Tenth St.
Johnstown, Messenger St. and B. & O. R.R.
Philadelphia....Second and Fishers Ave.
Pittsburgh .....1202 Chamber of Commerce Bldg.
Pottsville..Railroad and Sanderson Sts.
Scranton.....Penn Ave. and Vine St.
Shamokin.....Fifth and Walnut Sts.
Wilkes-Barre....150 E. Northampton St.
Williamsport.....Canal and Court Sts.

SOUTH CAROLINA
Charleston.....3 Liberty St.

TENNESSEE
Chattanooga.....312 Pound Bldg.
Knoxville.....426 West Depot Ave.
Memphis.....671 No. Main Street
Nashville..... 105-107-109 Broadway

TEXAS
Dallas.....1008 Canton St.
El Paso, First and Kansas Sts.....P. O. Box 103
Houston.....810-20 Live Oak
San Antonio.....115 S. Medina St.
Waco.....Thirteenth & Mary Sts.

UTAH
Salt Lake City..108 W. Second South St.

VIRGINIA
Lynchburg..... 1324 Commerce St.
Norfolk.....Virginia Ave. & Virginia Ry. P. O. Box 556
Richmond.....1709 E. Cary St.

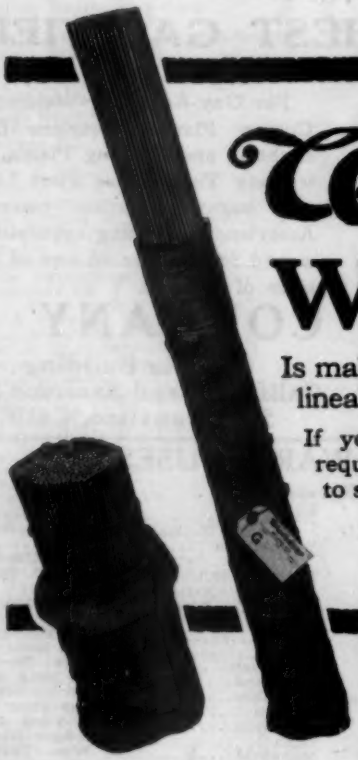
WEST VIRGINIA
Bluefield.....195 Roanoke St.
Charleston..Broad St. and K. & M. R. R.
Elkins.....Railroad Ave. and First St.
Fairmont.....Auburn St.
Huntington...Seventh Ave. & Eighth St.
Morgantown.....178 Clay St.
Mount Hope.....P. O. Box 536
Mullens.....Box 55
Wheeling.....43rd and McCulloch St.
Williamson.....P. O. Drawer L

WASHINGTON
Seattle.....304 Railroad Ave., South
Spokane.....162 So. Post St.

WISCONSIN
La Crosse.....Front and King Sts.
Madison..... 513-19 Williamson St.
Milwaukee.... 720 Jefferson St.

WYOMING
Casper.....218-234 Industrial Avenue

UNION CARBIDE IS EASILY OBTAINABLE EVERYWHERE



Weldite
Welding Metal

Is making sounder and tougher welds at a lower cost per lineal foot in thousands of welding shops.

If you have not tried Weldite, it will be worth your while to request samples, which will be gladly furnished free of charge to shop foremen and any others interested in welding.

Furnished Copper Coated for Gas Welding
Bare and Flux Coated for Electric Welding

Manufactured by

CHICAGO STEEL & WIRE CO.
103rd Street & Torrence Avenue, Chicago, Ill.

Hauck Mfg. Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Westinghouse Electric & Mfg. Co.
Burdett Oxygen Co.
Davis-Bournonville Co
International Oxygen Co.
Modern Engineering Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
The Imperial Brass Mfg. Co.
Torchweld Equipment Co.

TRUCKS (Cylinder Carriers)
Air Reduction Sales Co.
The Bastian-Blessing Co.
Burdett Oxygen Co.
Davis-Burnonville Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Modern Engineering Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.

VALVES (For Oxygen Cylinders)
Air Reduction Sales Co.
Bastian-Blessing Co.
Burdett Mfg. Co.
International Oxygen Co.
Mattingly Automatic Valve Co.

WELDING APPARATUS (Electric)
Electric Arc Welding & Cutting Co.
General Electric Co.
Quasi-Arc Weldtrode Co.
Westinghouse Elec. Mfg. Co.
Wilson Welder & Metals Co.

WELDERS' GLOVES
Air Reduction Sales Co.
Carbic Mfg. Co.
Chicago Eye Shield Co.
Davis-Bournonville Co.
Electric Arc Cutting & Welding Co.
International Oxygen Co.
Oxweld Acetylene Co.
Purox Co.
The Imperial Brass Mfg. Co.
Transportation Engineering Corp.

WELDERS' GOGGLES
Air Reduction Sales Co.
Bastian-Blessing Co.
Burdett Oxygen Co.
Chicago Eye Shield Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
Modern Engineering Co.
Purox Co.
Quasi-Arc Weldtrode Co.
Transportation Engineering Corp.

WELDERS MASKS
Chicago Eye Shield Co.
Electric Arc Welding and Cutting Co.
General Electric Co.
Torchweld Equipment Co.
Transportation Engineering Corp.
Wilson Welder & Metals Co.

WELDING RODS AND WIRE
Air Reduction Sales Co.
Electric Arc Cutting & Welding Co.
Bierman-Everett Fdy. Co.
Burdett Oxygen Co.
Carbic Mfg. Co.
William Cramp & Son
Central Steel & Wire Co.
Chicago Steel & Wire Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
International Oxygen Co.
Manganese Steel Forge Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Page Steel & Wire Co.
Quasi-Arc Weldtrode Co.
Purox Co.
Reid-Avery Co.
John A. Roebling's Sons Co.
Torchweld Equipment Co.
Transportation Engineering Corp.
Wilson Welder & Metals Co.

WELDING ROD HOLDERS
C. Sorensen.

WIRE AND CABLE (Asbestos Insulated)
Central Steel & Wire Co.
D. & W. Fuse Works, General Electric Co.

ALPHABETICAL INDEX TO ADVERTISERS

Amling, H. G. 41
Air Reduction Sales Co. ..... Front Cover
American Carbolite Sales Co. ..... Back Cover
American Welding Society 15

B

Bastian-Blessing Co., The 26-27
Bierman-Everett Fdy. Co. 50
Buffalo Dental Mfg. Co. 45
Burdett Mfg. Co. 10

C

Carbic Mfg. Co. ..... Inside Back Cover
Central Steel & Wire Co. 41
Chicago Eye Shield Co. 50
Chicago Steel & Wire Co. 8
Commercial Acetylene Supply Co. 8
Wm. Cramp & Sons 16

D

Davis-Bournonville Co. 50
M. Keith Dunham 17

E

Electric Arc Welding & Cutting Co. 49

F

Federal Brass Works 45

G

Gas Products Assn. 13
Gas Tank Recharging Co. 45
General Electric Co. 35

H

Harris Calorific Co. 15
Hauck Manufacturing Co. 14

I

International Oxygen Co. 50
Imperial Brass Mfg. Co. 50

K

K-G Welding & Cutting Co. 12

L

Liberty Welding & Mfg. Co. .....
Linde Air Products Co. 18

M

Manganese Steel Forge Co. 49
Mattingly Automatic Valve Co. 49
Alexander Milburn .....
Modern Engineering Co. 14
Modern Engineering Co. 41

N

National Carbon Co. 50

O

Oxweld Acetylene Co. 1

P

Page Steel & Wire Co. 5
The Prest-O-Lite Co., Inc. 31
The Purox Co. 3

Q

Quasi-Arc Weldtrode Co. 50

R

Reid-Avery Co. 37
Rochester Welding Works 4
Roebling, John A., Sons Co. 17

S

Sall Mountain Co. 49
Selboral Co. 47
C. Sorenson 47
Superior Oxy-Acetylene Machine Co. 48
Southern Welding Machine Co. 6
Shawinigan Products Corporation 16
Smith's Inventions, Inc. 11
Standard Carbide Sales Co., Inc. 12
N. A. Strand & Co. 50

T

Torchweld Equipment Co. 43
Transportation Engineering Corp. 14

U

Union Carbide Sales Co. 7
U. S. Gauge Co. 49
United States Welding Co. 14

W

Welding Metals Mfg. Co. 15
Westinghouse Electric Mfg. Co. 50
Wm. Wharton, Jr., & Co., Inc. 49
Wilson Welder & Metals Co. 43
Wodack Electric Tool Corporation 48

A word to the buyer of gas

COMMERCIAL Acetylene is made to meet the most exacting requirements of the careful welder. This means that every cylinder we supply is full of the purest acetylene gas which can be made. There is no variation in the quality.

Commercial Acetylene is sold on the free loan cylinder plan, which means that when you buy Commercial Acetylene you do not have to purchase cylinders. You buy only the gas which you use. No matter how much gas you use, this is the best way to buy it.

Submit your acetylene requirements to our nearest sales office, and we will be glad to give you complete details regarding the Commercial plan of buying acetylene.

Supplied in the following sized cylinders:

10x30 in.	125 cu. ft.
12x36 in.	225 cu. ft.
12x44 in.	275 cu. ft.

Commercial Acetylene Supply Company

Main Office: 80 Broadway, New York City
80 East Jackson Blvd., Chicago

Atlanta, Ga.
East Deerfield, Mass.
San Francisco, Calif.
Boston, Mass.
Los Angeles, Calif.
Bound Brook, N. J.
Blue Island, Ill.
W. Berkeley, Calif.

COMMERCIAL ACETYLENE

The basis of all good welding is gas pressure regulation. How about your equipment?

The two gas control devices illustrated here are typical of our complete line of accurate and sturdy appliances—*built for better welding.*

A Lighter, Simpler and Stronger Regulator

There is no other regulator like it on the market, at any price.

Price $30.00

The BURCO STA-SET (STAY SET) WELDING AND CUTTING REGULATOR

First decided regulator improvement in recent years. Total variation from wide open to closed 13 oz.

The only regulator with fully protected gauges. One dial shows both tank and line pressures.

So easily repaired that maintenance cost is reduced to a minimum.

Can be used for both welding and cutting, making it unnecessary to purchase two regulators.

Permits an accurate adjustment of the pressure, and then holds that pressure uniformly.

If your torches don't work right, old-fashioned regulators are probably the cause. You will save money in the end by discarding them and equipping throughout with the BURCO STA-SET.

BURDETT STANDARD HIGH PRESSURE VALVE

The letter at the right is typical of the experience of gas manufacturers who have standardized on BURDETT Valves. The BURDETT Standard High Pressure Valve is a better valve at a popular price.

Monel metal seat reduces gas leakage and cuts maintenance cost. Tobin bronze body gives long service.

It is the ideal valve for the gas manufacturer who wants to cut down valve replacement bills and reduce complaints from customers.

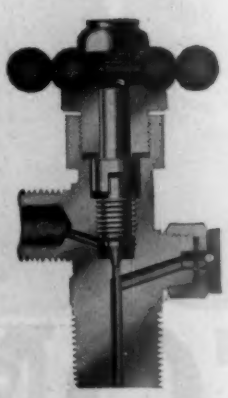
Submit your specifications and we will quote our latest prices on your valve requirements.

One of our valve customers says:

"For your information, we have standardized on your cylinder valves. We do not think there is a valve on the market which is fifty per cent as good and do not mind telling you that we would not give ten per cent as much for any other valve of which we know.

"We have not come in contact with all the oxygen valves made in this country, but will say that we have used a great many and not one compares, in our opinion, with the Burdett Valve at all favorably. When we have trouble we replace with your valve and our troubles are either over entirely or are so reduced that at least our office gets no word of it. We have never had a claim from 'empty drum' shipped, and this is one of the nightmares of the oxygen business."

(NAME ON REQUEST)



BURDETT MANUFACTURING CO.

309 St. Johns Ct. **Chicago, Ill.**

Test This New Way To Weld Cast Iron

THE new and proven better way you have waited for to weld cast iron. No new equipment needed. Just SMITH'S A-MAL-GAM, a welding torch and bronze filler rod. Easy to work with, faster to handle, *a sure weld.*

Eliminates pre-heating. By using SMITH'S A-MAL-GAM and bronze it is not necessary to bring the piece to be welded to a molten heat. Therefore it is now possible to weld without pre-heating many cast iron jobs that heretofore required pre-heating.

SMITH'S A-MAL-GAM

Forms a Perfect Bond Between Cast Iron and Bronze

Big jobs, little jobs—nearly all cast iron jobs. Weld them with SMITH'S A-MAL-GAM—right in your own shop—in shorter time—at faster, bigger profits—and better service. Comes packed in handy, non-tipping, moisture-proof 1 lb. cans. For the hours it saves and profits it adds, the cost of SMITH'S A-MAL-GAM is a small consideration.

MAKE THIS TEST YOURSELF!

Weld a bump of bronze on flat cast iron with SMITH'S A-MAL-GAM. Put in vise and knock it off. See how it tears out with it the cast iron to which it is welded fast! Try any test! You'll find that SMITH'S A-MAL-GAM makes the joint the strongest point.

SMITH'S INVENTIONS INCORPORATED

SEND COUPON TODAY–TRY SMITH'S A-MAL-GAM NOW!

Don't wait. Send the coupon now. Pay the postman $3.25 and postage for a 1 lb. can of SMITH'S A-MAL-GAM. Try it yourself, and if it does not do all we say, send it back for refund.

SMITH'S INVENTIONS, INC.
2623 4th St. S. E., Minneapolis, Minn.

Send me 1-lb. can SMITH'S A-MAL-GAM. I'll pay postman $3.25 plus postage when delivered.

MY NAME _____

STREET & NO. _____

TOWN _____ STATE _____

Please credit my jobber with this sale.

JOBBERS NAME _____

ADDRESS _____

"Standard Carbide gave me my start. I'm for it."

Says Smiling Dave Okay.

I was just one of the "bunch" until I discovered STANDARD. Now I'm Dave Okay, foreman.

As soon as I commenced using STANDARD CAR BIDE the boss began to wonder how I got that way. One day he called me into his office and asked me the reason for my sudden success; what I had done to better the quality of my work and increase my speed.

Then I uncorked all my enthusiasm for STANDARD and told him all about it; how it burns brighter and lasts longer because it is free from all impurities; how it is cheaper because it costs no more than other carbides; how I enjoy working with it and why increased production plus lowered cost makes STANDARD the logical carbide for any job.

Now the whole force uses STANDARD and our pride in our work and our boss's pride in us keeps our morale so high that we just can't be beat at any job, whether it is a matter of quality of work, speed of execution, or ultimate cost.

Smiling Dave Okay
(EXPERT CUTTER AND WELDER)

Contractors everywhere are beginning to realize that be cause STANDARD CARBIDE burns brighter and lasts longer, because it is packed in big blue steel moisture resisting drums and can be stored indefinitely without deterioration, because it costs no more than other carbides, it is cheaper and therefore the right carbide for all jobs.

STANDARD
CARBIDE
Burns Brighter—Lasts Longer

Standard Carbide Sales Co., Inc.
Main Office: : : 15 West 37th St., New York

COMPLETE UNITS
INSTALLATIONS
GENERATORS
and SUPPLIES

K-G WELDING AND CUTTING CO., Inc.
Home Office and Factory: 556 W. 34th St., New York City

Sales Offices:
PHILADELPHIA PITTSBURGH CHICAGO SPRINGFIELD, MASS
and NORFOLK

Send for
this FREE book

MANUAL of
INSTRUCTION
for
WELDING
OPERATORS

No charge—No obligation

A number of pages have been selected from THE WELDING ENCYCLOPEDIA, Third Edition, and published separately in the form of an instruction manual for welding operators. This manual contains lessons, exercises and examinations on oxy-acetylene welding and electric arc welding. It contains a color chart showing the appearance of metal at different temperatures, a color chart showing the appearance of the oxy-acetylene flame at different adjustments and two pages of illustrations showing step by step the procedure to be followed in setting up oxy-acetylene apparatus. This little booklet will be found invaluable to welding instructors, welding foremen, welding supervisors and welding students. It will be sent free to you upon request.

THE WELDING ENGINEER
608 S. Dearborn St., CHICAGO

Wherever You Are, You'll Get Service!

This map shows the nation-wide service of the Gas Products Association in supplying Oxygen and Hydrogen. The locations of plants having membership in the association, with their distributors and warehouses, are shown. Any of these plants can satisfactorily supply all your oxygen and hydrogen requirements, also all equipment and supplies for oxy-acetylene and oxy-hydrogen cutting and welding. In emergency, facilities of all plants are at your service, in addition to the plant with which you contract. Many large manufacturers and trunk line railroads have demonstrated their confidence in the service of these plants by contracting with them for their entire oxygen requirements.

Submit Your Welding Problems to the Nearest Plant

CALIFORNIA
California Compressed Gas Co., Los Angeles
California Compressed Gas Co., Oakland

COLORADO
Colorado Compressed Gas Co., Denver

ILLINOIS
Acme Oxygen Co., Chicago
Burdett Oxygen & Hydrogen Co., Chicago
Electrox Co., Peoria
Swift & Co., Chicago

INDIANA
Indiana Oxygen Co., Indianapolis
Logansport Oxygen Co., Logansport

IOWA
Bettendorf Oxygen-Hydrogen Co., Bettendorf

KENTUCKY
Kentucky Oxygen-Hydrogen Co., Louisville

MANITOBA
Auto-Lite Gas Co., Ltd., Winnipeg

MICHIGAN
Burdett Oxygen Co., of Detroit
Michigan Oxy-Hydric Co., Muskegon

MINNESOTA
Commercial Gas Co., Minneapolis

MISSOURI
Kansas City Oxygen Gas Co., Kansas City (two plants in Kansas City)

MONTANA
Mountaineer Welder's Supply Co., Butte

NEBRASKA
The Balbach Co., Omaha

NEW YORK
American Oxygen Service Company, New York

OHIO
Clarke Chemical Co., Wickliffe
Ohio Electrolytic Oxygen Co., Cincinnati
Ohio Oxygen Company, Niles

OKLAHOMA
Burdett Oxygen Co., of Oklahoma, Oklahoma City
Tulsa Oxy-Hydro Co., Tulsa

OREGON
Portland Oxygen & Hydrogen Co., Portland

PENNSYLVANIA
Burdett Oxygen Co., Philadelphia (Plants at Chester and Norristown)
Burdett Oxygen & Hydrogen Co., Pittsburgh

TENNESSEE
Burdett Oxygen Co., Chattanooga
Memphis Oxygen Co., Memphis

TEXAS
Burdett Oxygen Co., of Texas, Fort Worth
Magnolia Gas Products Co., Houston

UTAH
Utah Compressed Gas Co., Salt Lake City

WASHINGTON
Washington Compressed Gas Co., Seattle

WISCONSIN
Universal Oxygen Co., Sheboygan
Wisconsin Oxygen & Hydrogen Co., Kenosha

GAS PRODUCTS ASSOCIATION, 140 S. Dearborn St., Chicago

WELDERS MOULDING COMPOUND

Every Oxy-Acetylene and Electric Arc welder has undoubtedly felt the demand for a fire resisting compound which could be moulded into any desired shape. When building up metal around holes in castings, and where welding is necessary through a machined part, such as a bearing, much time and machining can be saved in addition to making a neater appearing job by employing such a compound. Carbon blocks and rods have their field, but it is very limited. "Welder's Moulding Compound" can not only be used wherever carbon has been, but it has a much wider field. Moulds can be made for any missing lugs or parts and new ones cast that have all the appearance of having been machined. Aluminum parts may be "backed-up," preventing the collapse of the metal when heating.

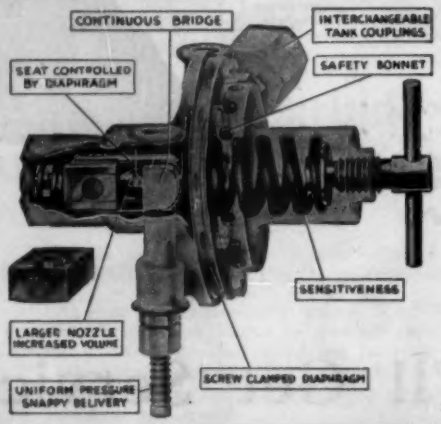
For aligning broken sections, whether large or small, the usual shimming process may be forgotten and much time saved by using this compound as a cushion for the work. It can be used in hundreds of different ways, over and over again—it don't wear out. The wide-awake welder will appreciate its true worth.

5-LB. CARTON, WITH MANUAL OF INSTRUCTIONS - - - $2.50

Manufactured only by

UNITED STATES WELDING CO., Inc., Minneapolis, Minn., U. S. A.

MAKERS OF FAMOUS "U. S." WELDING AND CUTTING APPARATUS.



Self laudation is seldom convincing but the opinion of others is not to be ignored

SAFETY SERVICE MECO EFFICIENCY ECONOMY

MULTI-SEAT REGULATORS

Modern Engineering Company

3411-13 Pine Blvd. St. Louis, U. S. A.

Mr. Torch Manufacturer will you give us an opportunity to convince you at our expense? Our prices will surprise you.

WELDING "TIPS" No. 1

"Would not be without it"

Why bother with costly and doubtful preheating methods?

Do it better, cheaper and faster with a Hauck **KEROSENE** Preheater.

Write for Bulletin 127

HAUCK MANUFACTURING CO.

Established 1900

122 Tenth St. Brooklyn, N. Y.

Wanamaker Coated Electrodes FOR ARC WELDING

COATED WANAMAKER ELECTRODES

Reduce your labor costs.
Reduce your current costs.
Reduce your electrode material costs.

Increase your production.
Increase the operators' efficiency.
Increase the quality of your welds.

Write for details.

The new Tecor Specialties Bulletin describes the WANAMAKER COATED ELECTRODES, also a complete line of welding accessories.

Write for it today.

Transportation Engineering Corporation

15 PARK ROW, NEW YORK CITY.

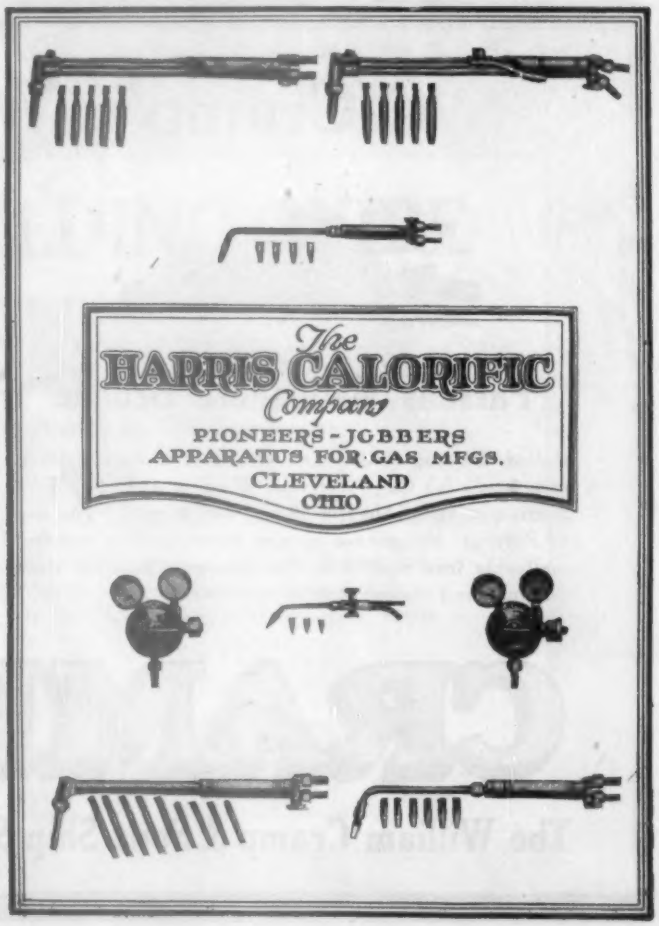
327 SOUTH LA SALLE ST., CHICAGO, ILL.

Welded Pressure Vessels

For several years efforts have been made to draw up a Code for the Welding of Unfired Pressure Vessels. Opinions of the best welding experts were not in agreement on many essential points. Fundamental scientific knowledge based on test data was not available. The American Bureau of Welding has completed a series of tests on some 47 tanks. The program involved an expenditure of over $15,000. The test data, analysis of same, conclusions and recommendations to the Boiler Code Committee of the A. S. M. E. has been compiled in a report, copies of which are available for distribution at $1.50 to members and $5.00 to non-members.

American Welding Society

33 West 39th Street New York, N. Y.



Scored Cylinders
AND
Cracked Water Jackets

made good as new without warping or removing from the car,

by the New Metal

Ferroite

Manufactured by

The Welding Metals Mfg. Co.

4403 Perkins Avenue :: Cleveland, Ohio

Write for exclusive agency

AUTOMOBILE WELDING

With the OXY-ACETYLENE FLAME By M. Keith Dunham

167 Pages* Price $1.50 *Fully Illustrated

This is the only complete book on the "Why" and "How" of Welding

Explains in a simple manner apparatus to be used, its care, and how to construct necessary shop equipment. Proceeds then to the actual welding of all automobile parts, in a manner understandable by everyone.

Gives principles never to be forgotten. Aluminum, cast iron, steel, copper, brass, bronze and malleable iron are fully treated, as well as a clear explanation of the proper manner to burn the carbon out of the combustion head.

Automobile Owners, Garage and Service Stations, Blacksmiths and Machine Shops, as well as industries using the oxy-acetylene flame, will find this book of the utmost value, since the perplexing problems arising when metal is heated to a melting point are fully explained and the proper methods to overcome them shown.

CONTENTS

CHAPTER I.—APPARATUS KNOWLEDGE.
Oxygen Supply—Care of Oxygen Cylinder—Acetylene Generation—Care of Generator—Regulators—Care of Regulator — Creeping Regulators — Gauges—Care of Gauges—Welding Torch—Care of Welding Torch—Effects of Heat—Hose and Goggles.

CHAPTER II.—SHOP EQUIPMENT AND INITIAL PROCEDURE.
Preheating Agencies—Welding Table—Location of Welding Outfit—Starting the Welding Outfit—Adjustment of Flame—Principle of Welding—General Welding Knowledge—Welding Rods and Fluxes—Choice of Tip—Expansion and Contraction.

CHAPTER III.—CAST IRON.
Simple Welding—How to Hold the Flame—Hard Cast Iron—Pin Holes and Blow Holes—Lug on Cylinder—Water Outlet—Cylinder Welding—Compression Head—Finishing and Testing—Scored Cylinders—Cylinder Parts—Fly Wheels—Pistons—Crank Cases — Babbitted Bearings — Valve Guides—Preserving Threads—Conclusion of Cast Iron.

CHAPTER IV.—ALUMINUM.
Use of—Welding Knowledge—Puddle System—Flux System—Comparison of Systems—Welding Rod—Preparation of the Weld—Inlet Manifold—Arm of Crank Case—Welding the Arm Without Taking Out the Motor—Break in the Body of Case—Welding Cold—Wrong Method of Setting Up—Lug or Boss Welding—Preheating the Case—Gas Preheating Flame—One Side or Both—Collapse of Weld—Broken Bearings—Direction of Welding—Shrinkage Cracks—Missing Parts—Finishing—Die Moulded Castings—Body—Other Parts.

CHAPTER V.—STEEL.
Welding Knowledge—What the Flame Does to Steel—The Welding Rod—Simple Welding—Position of Flame—Reinforcing the Weld—Frame Welding—Lengthening the Chassis—Tube Housings—Worn Parts—Gear Welding — Case Hardening — Light Metal Welding—Gasoline Tank—Welding Adjacent to Rivets—Shaft Welding—Construction of Parts.

CHAPTER VI.—MALLEABLE IRON, COPPER, BRASS, BRONZE.
How to Detect Malleable Iron—Brazing Malleable Iron—Rear Housing—Reinforcing the Brace—Brazing Tube to Housing—Building Up Worn Parts—Copper—Brass and Bronze—Silver Soldering.

CHAPTER VII.—CARBON BURNING AND OTHER USES OF OXYGEN AND ACETYLENE.
Principle of Carbon Burning—Method of Operation—Lead Burning—Soldering—Case Hardening—Heating Uses.

CHAPTER VIII.—HOW TO FIGURE COST OF WELDING.
Oxygen Consumption—Dissolved Acetylene Consumption—Torch Consumption Test—Acetylene Generator Consumption—Cost Card—Conclusion.

Sent to any address Post-paid on receipt of $1.50 **THE WELDING ENGINEER** 608 So. Dearborn St. CHICAGO IL

Cramp's Welding Rods

Parsons' Manganese Bronze

Rolled Welding Rods—The strongest bronze welding rods made for Oxy-Acetylene Welding and High Fire Brazing of Malleable Iron, Brass and Bronze. The use of Parsons' Manganese Bronze Filler Rods in brazing malleable iron results in the strongest possible weld or braze and insures satisfactory work.

We also furnish Welding Rods of Cast Iron, Copper Covered Iron and American Iron for welding steel, Vanadium Steel, Nickel Steel, Cast Aluminum, Drawn Aluminum, Soft Brass and Phosphor Bronze, also Steel Electric Welding Rods both flux covered and uncoated.

Cramp's Cast Iron Solder

for repairing Scored Cylinders and Water Jackets, etc. Thoroughly tried for several years by our customers and found entirely satisfactory.

Cramp's Aluminum Solder

A joint properly made with this solder is stronger than the original casting and is preferable to a welded joint.

CRAMP

We furnish and will be glad to estimate on all kinds of brass and bronze castings.

The William Cramp & Sons Ship & Engine Building Co., Philadelphia

Our business is Good—

it ought to be—

CANADIAN CARBIDE

is Good Carbide

SHAWINIGAN PRODUCTS CORPORATION 110 WILLIAM ST. NEW YORK

SHAWINIGAN

ROEBLING WELDING WIRE

Conforms to specifications of The American Welding Society.

Gas Welding Wire

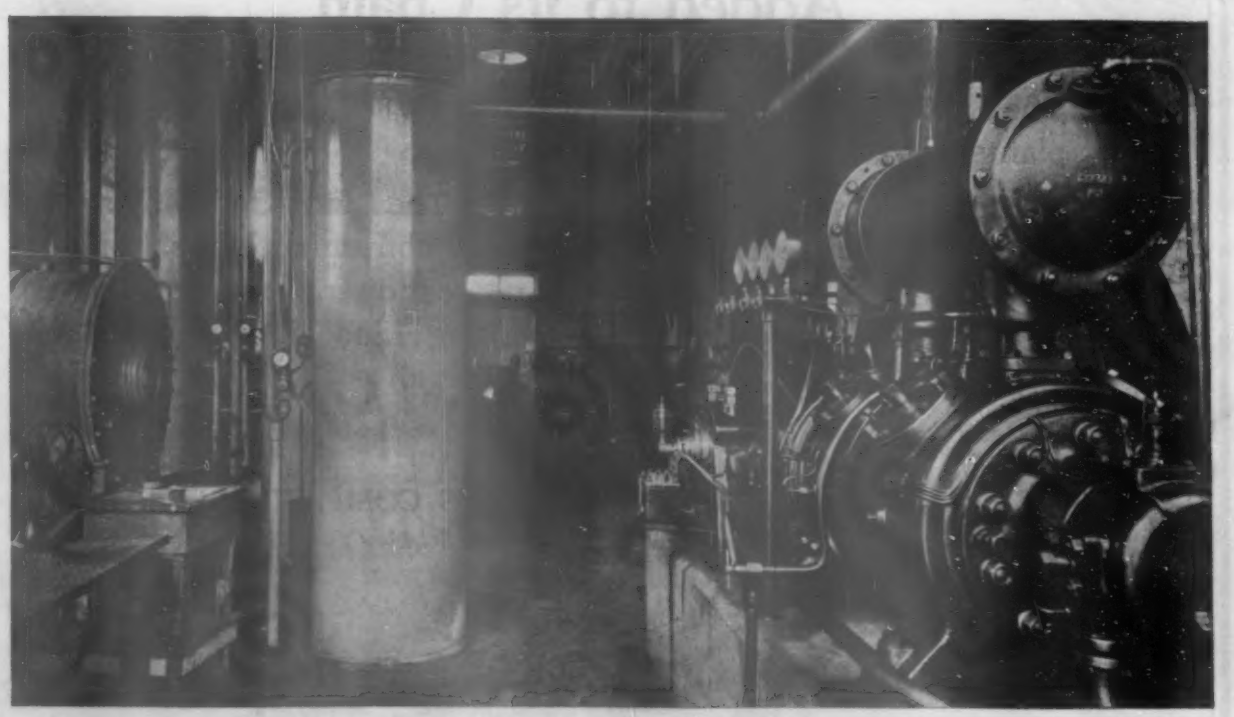
Low Carbon Electrodes **High Carbon Electrodes**

ROEBLING WELDING WIRE gives satisfactory service and demonstrates its efficiency and reliability. Exacting tests have proven that it possesses those qualities essential to good welding. If you are not using our welding wire, it amply merits your consideration.

Roebling copyrighted trade-mark JR stamped on each Electrode

JOHN A. ROEBLING'S SONS COMPANY
TRENTON, NEW JERSEY

New York Boston Chicago Philadelphia Pittsburgh Cleveland
Atlanta San Francisco Los Angeles Seattle Portland, Ore.



OXECO LIQUEFACTION OXYGEN PRODUCING PLANT
THE BAIN-BEAIRD CO., Shreveport, La.

Sold by

M. KEITH DUNHAM 110 S. Dearborn St. CHICAGO, ILL.

Two New Linde Links Added to its Chain

The Linde Company is pleased to announce the opening of plants at Pittsburgh and Savannah.

These two new plants are evidence of The Linde Company's desire to place every facility within convenient reach of its customers. An inquiry to our nearest district sales office will bring you information concerning Linde Engineering and Distribution Service for Linde Users.

For your convenience—33 plants—58 warehouses

THE LINDE AIR PRODUCTS COMPANY
Carbide and Carbon Building, 30 East 42d St., New York City
The Largest Producer of Oxygen in the World

District Sales Offices:

Atlanta	Chicago	Kansas City	New York	Savannah
Baltimore	Cleveland	Los Angeles	Philadelphia	Seattle
Boston	Dallas	Milwaukee	Pittsburgh	St. Louis
Buffalo	Detroit	New Orleans	San Francisco	

LINDE OXYGEN

Metallography and Testing of Oxy-Acetylene Welds*

Science of Metallurgy Points to Ways of Avoiding Common Imperfections Found in Welding Practice

By J. R. Dawson†

Abstract

This paper deals with the application of oxy-acetylene welding to various classes of steel and to cast iron. Photographs are included to illustrate the effect of the process on the structure of metals that are welded. The physical properties of welded metals are discussed and illustrated by typical test results.

The author has emphasized that oxy-acetylene welds are quite dependable when the work is done under suitable conditions and with proper supervision. Stress has been laid on the need for testing of the welder's work. The opportunities for saving, that result from greater use of the welding have been mentioned, and a plea made for the application of the principles of heat treating to welding problems, which are of a nature to require metallurgical knowledge.

WELDING is a metallurgical operation. Since we, as steel treaters who devote our experience and thought to proper control of metallurgical practice and correct heat treatment methods, are frequently called upon to decide the suitability of welding applications to production work and repairs of products or plant maintenance, the author ventures to present briefly, results and conclusions arrived at in the course of extensive research in the problems of oxy-acetylene welding and cutting.

The extent of the metallurgical features of oxy-acetylene welding may well be appreciated from the consideration that molten metal under the gas flame is comparable to the bath of an open-hearth furnace, and is subject to treatments similar to those given the open-hearth bath, such as changes of composition due to oxidation, addition of alloys, and interchange of elements between the metal and slag. Furthermore, metal adjacent to the zone of deposited metal is necessarily heat treated to some extent, and throughout all investigations of welds and welding this heat-treatment factor is of importance.

Importance of Competent Welders

The results obtained in fusion welding are quite uniform and dependable when suitable materials are used and the work done by competent welders. The most important element affecting weld quality, is the manner in which the operator handles the work. The following factors are also of importance in securing satisfactory quality of welding:

1. *Selection of Men*

Most men of average ability can become good welders. The requirements are honesty, patience, and a reasonable amount of manual dexterity.

2. *Training Methods*

Training is obviously of the same importance for this work as for that of other crafts. Mention should be made at this point of the excellent work of the American Welding Society Committee on Training Operators.[1]

3. *Supervision*

Those in charge of welding work should understand the properties of the metals being handled and of the welded article, and they should know enough of the details of correct welding methods to judge the quality of the work being done.

To prove the quality of a welder's output, it is only necessary to use the tensile or bend test on a number of specimens made by him, welding materials of satisfactory quality, having been provided. Check-tests of welder's work are of great importance and should be made regularly by competent supervisors who are capable of recognizing the quality of welding.

Until recently, little distinction was made between welding rods and ordinary wire, but the need of suitable, good quality rods, is of first importance, for the quality of the resulting deposited metal is largely dependent upon the rod used.

Quality of Welding Rods

Fig. 1 shows welding rod steel that is practically free from non-metallic inclusions. Fig. 2 is of welding rod steel that is unsatisfactory on account of the large number of non-metallic inclusions. When the dark areas are examined at higher magnification they are seen to contain small slag particles. Welding rods of quality illustrated by Fig. 2 are quite common but the better quality material can be made and tons of welding rods of high purity are consumed every month. Flame melting tests have been devised that will discover the steel containing nonmetallic inclusions and dissolved or occluded gases. One such test that is often applied, is to place the welding rod in a horizontal position and pass a welding flame of suitable size over its length at such uniform rate as to melt half way through the rod. It should melt and flow together evenly without boiling or throwing off sparks. If the steel contains gases the metal upon solidifying will be of spongy appearance. The "dirt" contained in the steel can be observed during the melting, as it reflects more light than the metal and appears as brilliant white spots or lines. When such inferior rods are used it is difficult to prevent the inclusion of impurities and gas pockets in the weld.

Low-Carbon Steel Welding

At present most steel welds are made with rods of the following composition:[2]

Carbon—Not over	0.06 of one per cent
Manganese—Not over	0.15 of one per cent
Silicon—Not over	0.08 of one per cent
Sulphur—Not over	0.04 of one per cent
Phosphorus—Not over	0.04 of one per cent

Rods of other compositions are also available and some of them will be described later in this paper.

The tensile strength of a double V weld, properly made in ½-inch plate with a low-carbon steel rod is about 52,000 pounds per square inch, but experience has shown that without knowledge, care and skill, a weld of this strength will not be obtained. It is quite necessary that sample welds be tested, because many welding operators permit imperfections in their work and do not know it. A simple test is to place a specimen in a vise with the center of the weld at the top edge of the jaws and to hammer until fracture occurs. Inspection of the fracture will reveal the nature of any defects and by practice and repeated tests the faults may be overcome. The ability of each welder should be tested in this way, or better, by pulling the welds in a testing machine, before he is permitted to do important work. Occasional tests should be required to prove that a proper standard of efficiency is being maintained. This point may be illustrated by results recorded in Table 1, of a series of tests of welds made on consecutive days.

This example is entirely typical of a welder with considerable

---

*A paper presented before the annual convention of the Society, Pittsburgh, October 8-12, 1923.

†*Union Carbide and Carbon Research Laboratories, Inc.*

[1] *Bulletin of the American Welding Society, May, 1923.*

[2] *Welding Wire Specifications and Folios, American Welding Society, Bulletin No. 2.*

experience, unknowingly doing poor work and making almost 100 per cent improvement once his mistakes are demonstrated.

A series of experiments were recently carried out to determine the physical properties of weld metal. Blocks of metal were deposited so that test specimens about 4x⅜x1½ inches could be

Fig. 1—Polished but Unetched, Good Quality Welding Rod.

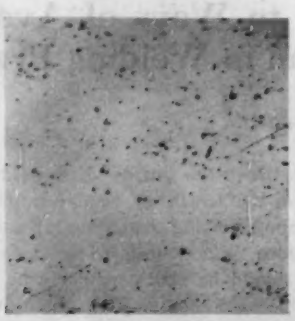


Fig. 2—Polished but Unetched, Poor Quality Welding Rod.

machined out, and the results as shown in Table II were obtained in testing the untreated material.

In this table the results for tensile strength compare favorably with those obtained in testing annealed low-carbon steel, but

Table I

Tensile Tests of Single "V" Welds

Each Value is the Average of Five Tests

Day Welded	Ultimate Tensile Strength Pounds per Square Inch	Elongation Per Cent In 2 Inches
1st	27,000, equivalent to strength obtained by single riveting	3.2
2nd	37,500	6.5
3rd	43,200	12.4
4th	46,100, equivalent to strength obtained by triple riveting	11.5

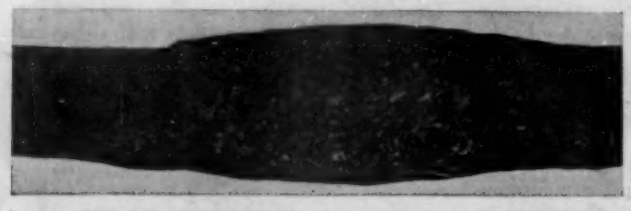


Fig. 3—"V" Weld in ⅝ Inch Low-Carbon Steel Plate, Etched with Ammonium Persulphate.

the elongation and reduction of area are not so good as in rolled plate. It is of interest to note that in tests of welds made in

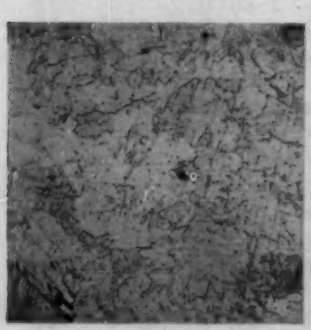


Fig. 4—Structure of a Low Carbon Steel Weld Metal.

Fig. 5—Structure at Junction of Nickel Steel Weld Metal, at Left and Coarsened Low Carbon Steel Parent Metal, at Right.

similar materials with a given type of rod, that elongation and reduction of area vary with the tensile strength while in rolled material one usually increases as the other becomes less.

In Fig. 3 the darker material near the center is filled-in weld metal whose grains are relatively coarse. The structure of the base metal adjacent to the weld has been coarsened by the high temperature attained at that point. It may be observed that the structure of a portion of the weld metal and surrounding base

Fig. 6—Bending Tests of Welds, Actual Size.

metal had been refined when the second side was welded. At a distance from the weld of about 3 times the base metal thickness, a temperature has been reached which was just high enough to refine the base metal grains. This is the point of greatest ductility and of lowest strength of base metal. Tensile tests specimens often break in this zone.

Fig. 4 shows the structure of low carbon steel weld metal. This material is similar in structure to a steel casting, and is practically carbonless. The scattered small black dots throughout the area are believed to be ferrous oxide.

Experiments have been made in annealing low carbon steel welds, in which it was found that a temperature of 1,750 degrees Fahr. was required to refine the grains. This high temperature coarsens the base metal and to obtain good structure throughout the section a second annealing at 1,450 degrees Fahr. is required. Annealing does not increase the weld strength but does make some improvement in ductility.

An outstanding feature of recent development in low carbon steel welding is the success attained in welding steel and wrought

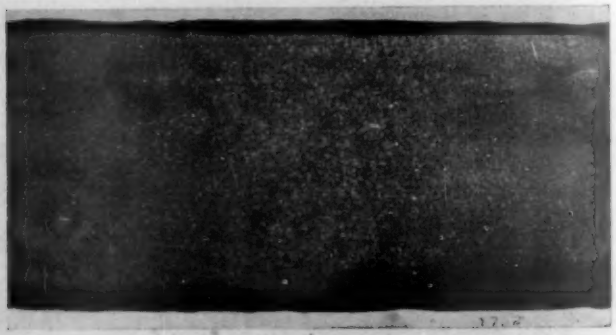


Fig. 7—Steel Forging Cut by Oxy-acetylene Blowpipe.

iron pipe. Until rather recently only a limited amount of steam, oil, gas, and water carrying pipes were welded. Studies have shown that the welding is not only less expensive than other methods of installation in first cost, but that it has a tremendous advantage due to the avoidance of leakage with its attendant loss of product and expense for repair and damage. Because the screw joint weakens the pipe at the thread, and flanges or caulked joints are loosened by strains or vibration, it is not unusual to have a loss of 10 to 20 per cent of fuel gas or illuminating gas by leakage from lines having such joints. Leaking gas always brings to mind the hazard of carbon-monoxide poisoning. Welded oil carrying lines do not require frequent inspection, and so the need for line walkers is largely eliminated.

Table II

Tensile Tests of Weld Metal Deposited with Oxy-acetylene Flame

Specimen Number	Size	Pounds Per Square Inch Yield Point	Tensile Strength	Elongation Per Cent In 2 Inches	Per Cent Red of Area
1	1.483 x .366	36,000	49,100	29.0	26.9
2	1.503 x .386	32,300	53,500	36.0	41.0
3	1.507 x .381	37,000	50,800	32.0	35.9
Average		35,100	51,100	32.0	34.6

The advantages of these pipe welding applications have led to welding of high pressure steam lines and success has attended the efforts. The basis of this success was the testing of work done by the welders. Before a recent installation of a 21-inch welded steam line to carry 165 pounds pressure, the operators were required to weld around a joint which was later tested by cutting in strips across the weld and breaking it in the tensile machine. A surprising result of this test was that the specimens from the bottom of the pipe where overhead welding was required, were better than from other parts of the pipe. The explanation for this is that a relatively small flame must be used for overhead welding and better opportunity was given for careful work and the avoidance of overheating.

Medium Carbon Steel

It is sometimes recommended to weld medium carbon steel with medium carbon steel welding rods but tests as to strength of weld have shown no advantage over welds made with low carbon rods. As illustrated by Table III, the weld metals obtained from the two rods are of practically the same chemical composition.

The loss of carbon is less with the nickel steel and a stronger weld is obtained when it is used. Fig. 5 illustrates the structure at the junction of nickel steel weld metal, at the left, and the coarsened low carbon steel parent metal, at the right. This lacy structure is characteristic of a nickel steel weld metal. The junction of two types of structure affords an excellent opportunity to observe the method of intermingling of the two metals by the growth of grains across the boundary.

An objection sometimes aimed at welding is: "Well, the tensile strength is all right but the enlongation and contraction are low. What will happen when the weld is subjected to bending and alternating stresses?" The average tensile strength of a well made low carbon steel weld is 52,000 pounds per square inch and the average reinforcement is 20 per cent of the plate thickness, so that the available strength of the joint is 60,000 pounds per square inch of plate section. Most low carbon steels are of less strength. If greater weld strength is desired rods of special composition will produce a weld of 58,000 to 60,000 pounds per square inch of plate, and reinforcement will still further increase this figure to about 70,000 pounds per square inch as referred to base metal thickness. Inherently and by reason of the reinforcement, the weld is also stiffer than the plate metal, so that bending stresses are resisted by the weld and bending occurs in the adjoining metal as illustrated in Fig. 6.

These are single "V" welds in ½ inch low carbon steel plate with the standard low carbon steel welding rod. These 1½ inch

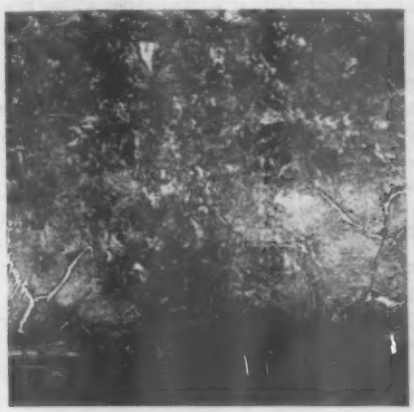


Fig. 8—"Burnt" High Carbon Steel, Near Weld.

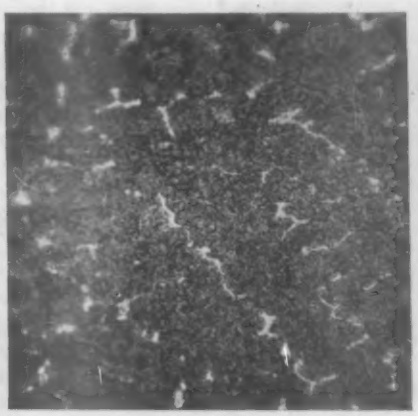


Fig. 9—Welded High-Speed Steel Tool Tip.

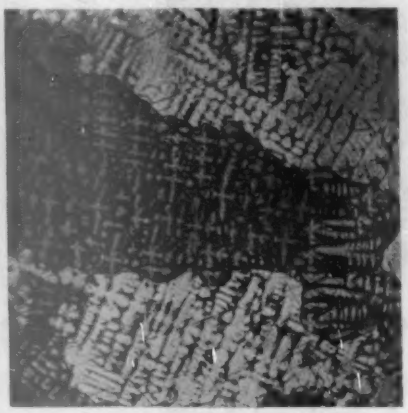


Fig. 10—Manganese Steel Weld Metal.

Table 3

Chemical Analysis of Rods and Welds

	Per Cent Carbon	Per Cent Manganese	Per Cent Silicon	Per Cent Nickel
Low carbon steel rod	0.07	0.15	.007	
Weld made with it	0.05	0.10	.004	
Medium carbon steel rod	0.24	0.41	.043	
Weld made with it	0.08	0.32	.004	
Nickel steel rod	0.24	0.62	0.21	3.11
Weld made with it	0.12	0.36	0.03	2.83

Fig. 11—Manganese Steel Base Metal, Near Weld.

Fig. 12—Same as Fig. 11, at Higher Magnification.

Fig. 13—Manganese Steel Weld Metal.

wide strips were cut from the welded material and bent at the weld by holding in a vise and striking with a sledge hammer. When this bending was carried as far as possible the specimens were brought to the form shown by steam hammer blows. At first, most of the bending was outside the weld but in this case the heavy blows forced the weld to bend to about a ½-inch radius. In a recent valuable paper [2] describing extensive investigations of endurance properties, it was pointed out that endurance properties are definitely related to tensile strength and that for many uses too much importance has been given to ductility. Increase of tensile strength increases the resistance to fatigue failure. Since the weld can and should be made of greater strength than

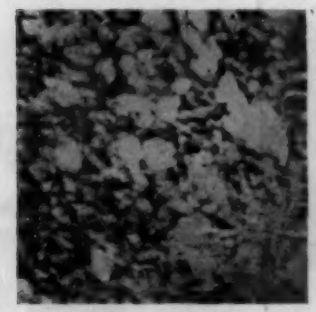


Fig. 14—Heat Treated Manganese Steel Weld Metal.

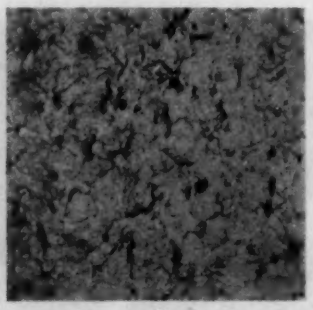


Fig. 16—Photomicrograph of Gray Iron Weld Metal.

the metals joined, high resistance is offered to alternating and other stresses and should the use require ductility it will be obtained from the material surrounding the weld.

As has many times been pointed out, a weld is only a casting, but there are certain differences from most castings. The weld metal is molten only an instant. Time is given for impurities to float to the surface, and then the blowpipe is advanced and the metal freezes. The volume of melted metal is so small that solidification occurs before extensive dendritic structures have had time to form, and therefore some of the objectionable features that are associated with steel castings are not encountered in welds.

Those engaged in the art of heat treating are familiar with the effects of sonims and other imperfections on the quality of the steel they use. The welding engineer is also deeply concerned with

Fig. 15—Weld in Gray Iron.

the problem. The quality of base metal has a decided influence on the weld obtained. There is a certain amount of intermingling of the base metal and filling rod metal, as both are melted together to form the weld. If slag particles of the base metal are numerous there is a tendency for films of oxide to be formed around the grain boundaries at the junction of weld and base metal, and also at times lines of oxides are found deposited in the high temperature ferrite grain boundaries of the base metal adjacent to the weld but not melted during welding. This oxide was no doubt dissolved by the metal when at high temperature and rejected to the grain boundaries during cooling. Steel containing gases is especially objectionable when used in the form of sheet metal for welding. Porosites are formed by gases that escape during solidification of the melted steel.

[2] *D. J. McAdam, Jr., American Society for Testing Materials, Proceedings, 1923, entitled "Endurance Properties of Steel: Their Relation to Other Physical Properties and to Chemical Composition."*

Steel Forgings

It is impossible to formulate rules for welding of steel forgings that will be of general application. The following must be considered:

1. The chemical composition
2. The stresses the metal at the weld must endure
3. Possibility of heat treatment

It should be kept in mind that the metal near the weld is heated and the extent of the effect depends upon the temperature attained and the length of time at that temperature. This heating may create a structure less desirable than the original and will certainly produce a difference between the structures of the weld and surrounding metal, and the remainder of the forging. If the weld is required at a point where only small stresses will be applied to the part in service, welding of course is permissible. If suitable heat treatment can be economically applied to the welded forging structural uniformity will be regained.

A use of the oxy-acetylene process that is becoming of increasing importance is the cutting of steel forgings, by which, in a wide variety of instances great savings are made by reduction of the amount of machinery necessary to complete the part.

Fig. 7 is a macrograph of section of a forging 5 inches thick after cutting with the oxy-acetylene cutting blowpipe. The structure of the darkened area on upper side of picture, has been altered by the heat incident to cutting. This area is less than $\frac{5}{16}$ inch in depth. Further investigation of this material shows that annealing removes the difference of structure. Researches have developed the following information:

Fig. 17—Photomicrograph of Gray Iron Casting.

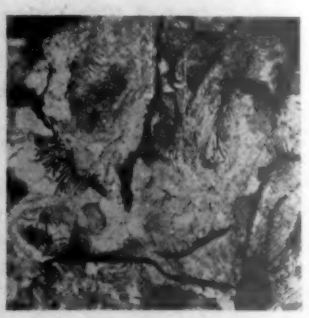


Fig. 18—Photomicrograph of Gray Iron Weld Metal.

1. Steel containing less than 0.40 per cent carbon can be cut accurately and smoothly without difficulties of any sort, and with great saving of time and expense.
2. Preheating to about 800 degrees Fahr. is advisable when the carbon content is above 0.40 per cent, for if the steel happens to be of poor quality small cracks may occur unless this precaution is taken.

High Carbon Steel

As the carbon content of steel becomes greater the metal is more easily overheated with attendant difficulty in obtaining high strength welds. A capable welder will not "burn" steel containing 0.90 per cent or less carbon. Fig. 8 shows the structure of a 1.10 per cent carbon steel that has been welded. The "burnt" area shown was on the bottom side near the weld. The black lines at the grain boundaries show the burning. They are really cracks. The top of the specimen was enveloped by the welding flame and protected from oxidation.

An important welding application to the higher carbon steels is filling up to original form of areas that have been worn. By correct selection of welding rod, the repaired portion is frequently made more resistant to wear than the original metal. From the standpoint of welding, alloy steel may be classed with forgings. There are many instances where the process may be

(Continued on Page 42)

BRITISH WELDING EXHIBITION

Report of Welding Exhibitions at Shipping, Engineering and Machinery Exhibition Recently Held in London

By Lorn Campbell, Jr.*

THE Shipping, Engineering and Machinery Exhibition held at London, England, from August 31st to September 22nd had the largest display of oxy-acetylene and electric welding and cutting apparatus ever shown under one roof by British manufacturers. This exhibition, which is held every two years, took place at Olympia. The facilities for staging shows of this type are remarkable. The glassed roofs; general grouping principle and numerous cafes operated within the building, make an ideal setting. An indexing and locating device typifies the care which has been taken throughout, to make it an ideal Exhibition Palace. This machine is located in the center of the hall and bears the

A Novel Welding Torch, The One Control Lever Causes Both Oxygen and Acetylene Valves to Function.

names of all exhibitors. Opposite each name is a button which, when pressed, lights up the space occupied by that company on an adjoining map. From this, a visitor can instantly locate any particular exhibit.

As the name would indicate, the field covered by the exhibition is a very large one. Practically everything pertaining to shipping, engineering and machinery, is on display. But the fact that the number of welding equipment exhibitors, as well as the amount of apparatus and work shown, is the largest ever gathered for display in Great Britain bears testimony to the continued growth of the industry.

Each exhibitor had an experienced welder and cutter in attendance. Demonstrations were put on continuously. In order to permit the onlookers to gaze at the work in process the tables were well screened and in some instances covered entirely with colored glass. Oxygen and acetylene cylinders were kept in each booth, but where the acetylene was supplied from generators these were located outside the main building and the gas piped in. This not only applied to the gas when used for welding and cutting, but for lighting as well.

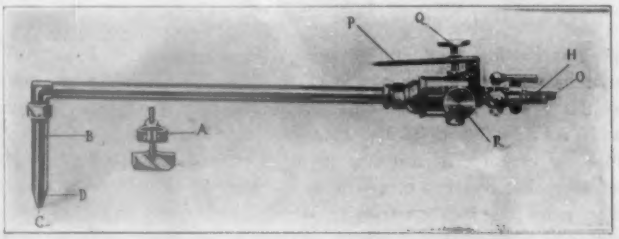
Practically all of the gas apparatus shown was of the low pressure type, wherein the acetylene or fuel gas is supplied under little or no pressure and depends upon the oxygen, under considerable pressure, drawing it to the tip by means of an injector. The reason for the prevalent use of this type of equipment has been due to the fact that acetylene generators, other than those designed to give pressures at approximately one-half pound, have never been looked upon with favor. However, within the past year permission has been granted to allow the use of generators, wherein a pressure not exceeding ten pounds may be used. This, no doubt, will tend to gradually change the type of apparatus for it will allow a greater range in design than is now in general use. At the present time most of the torches are anything but well balanced. This is due almost entirely to the extra large hose used to convey the gases. With the acetylene under such low pressure it is only natural that as large an opening as possible be used in the hose. But the large hose requires connections in proportion. In addition to this the valves are built accordingly and in some instances they might be termed "huge." The oxygen valves are of the needle type, but there are no stops to prevent the needle from being screwed all the way out. In a few instances the acetylene valve has been entirely dispensed with. (When used with a low pressure generator, the pressure requires no regulation so the oxygen is depended upon for the flame regulation.) Where acetylene valves are used they are not of the needle type but invariably of the ground plug type with no packing of any kind. While this proves quite satisfactory for low pressure work, no doubt a packed needle valve will make its debut with acetylene gas under pressure.

The regulators were all of the diaphragm type using various arrangements for closing the seats. Many of the pressure gauges lacked the quadrant movement. They were of the executive design. Most of the generators employed a very large size carbide, and the use of a gas bell in connection with the generator is very common.

The display of electric welders was on a par with the gas apparatus. All types were shown and plenty of evidence in the form of sample welds were on hand to substantiate all claims made. The following is an alphabetical list of the various companies with displays pertaining to welding and cutting:

Allen-Liversidge, Ltd.

This company had two exhibits; one showing oxy-acetylene equipment and the other electric welders. Inasmuch as this firm occupies a domineering position as regards the manufacturer



Popular Type of British Cutting Torch.

of dissolved acetylene, considerable interest was directed to acetylene in cylinders. Various sized cylinders were shown, from the smallest motorcycle type to the largest welding size. A sectioned cylinder showing the style of filling material and general construction proved interesting. Included in this exhibit was a very complete line of apparatus for welding, cutting, surface hardening, brazing, soldering, lead burning, cable jointing, plumbers' work and paint burning. In addition to the acetylene generators for welding, searchlight projects, flarelights, miners' and general utility lamps were also included. In the electric welding booth, Lincoln automatic arc welders, Pontelec resistance welding and heating apparatus together with electrodes and arc welding accessories were on view.

Alloy Welding Processes, Ltd.

This concern displayed a portable arc welding plant of their own design, as well as a special assortment of electrodes. The self-stabilizing dynamo was driven by a 10 horsepower engine, speed 1,200 R. P. M. The open circuit voltage was 70, which decreased as the load was applied. The range, from 50 to 200 amperes. Interesting samples and demonstrations were shown which included special applications to copper and its alloys.

Anglo-Swedish Electric Welding Co., Ltd.

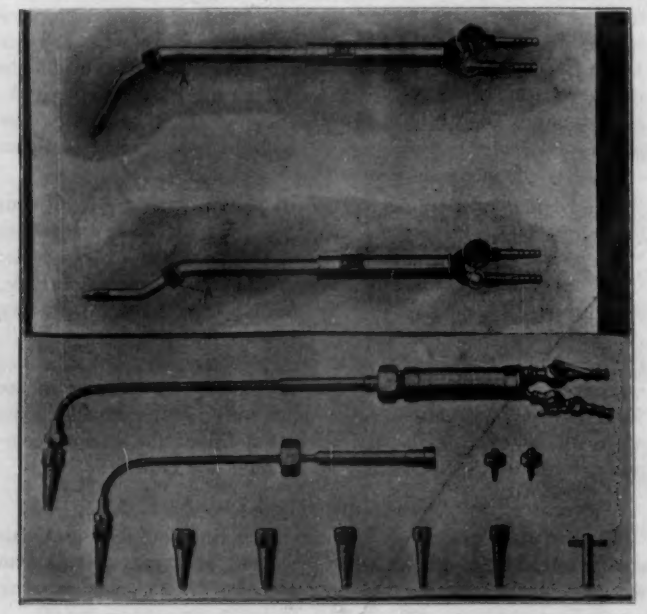
Holding exclusive British rights under the Kjellberg patents, this company exhibited speciman welds to demonstrate the superior

*Sales Engineer, U. S. Welding Co.

features of its process. Extensive tests were shown. In the main, they were as follows: alternative stress, bending, elasticity, impact, tensile and torsional.

British Oxygen Co. Ltd.

This company had a large and interesting exhibit of oxy-acetylene welding and metal-cutting apparatus manufactured by themselves in their engineering works at Edmonton, a suburb of London. One of the most interesting of the novelties shown was a cutting machine which the company had recently designed and constructed to meet a demand for a shop tool by means of which



Different Types of Welding Torches.

oxygen cutting to template might be readily carried out. The machine consisted essentially of a jointed swinging arm similar to the type commonly employed in drilling machines, combined with an adaptation of the magnetic clutch principle to hold the rotating member of the cutting head in contact with the template or former. By this means a uniform rate of cutting is assured. The machine was electrically driven by means of a ¼ H. P. motor. Any of the standard cutting heads manufactured by the company can be adapted for use in this machine, but they state that for a clean finish on new work up to 4 inches in thickness the oxy-coal gas cutting head gives even better results than oxy-acetylene.

The company also showed a new type of hand cutter which, although preserving all the special characteristics of their old style hand cutter, is specially designed to enable an ordinary operator to take it apart for cleaning when required. The cutter was shown in operation. Specimens of cutting work done by both hand and machine cutters were exhibited.

The exhibition of plants for the production of oxygen, nitrogen, hydrogen, carbonic acid, argon and other gases, together with gas compressors and appliances, occupied a prominent position.

Buckley, Saunders & Co., Ltd.

The electric spot welders shown by this company were fitted with automatic trip switches for cutting off the current at the will of the operator. This feature is intended to overcome the difficulty usually experienced when working springy material. A current regulator, swiveling pedal and adjustable arms were other features. Butt welders of different capacities; universal machines for heavy and multiple spot, press, cross and disc welding; seam welders; arc welders of stationary and portable types; chain welders with automatic feed, as well as rivet heaters made up a very complete exhibit.

Carbic Co., Ltd.

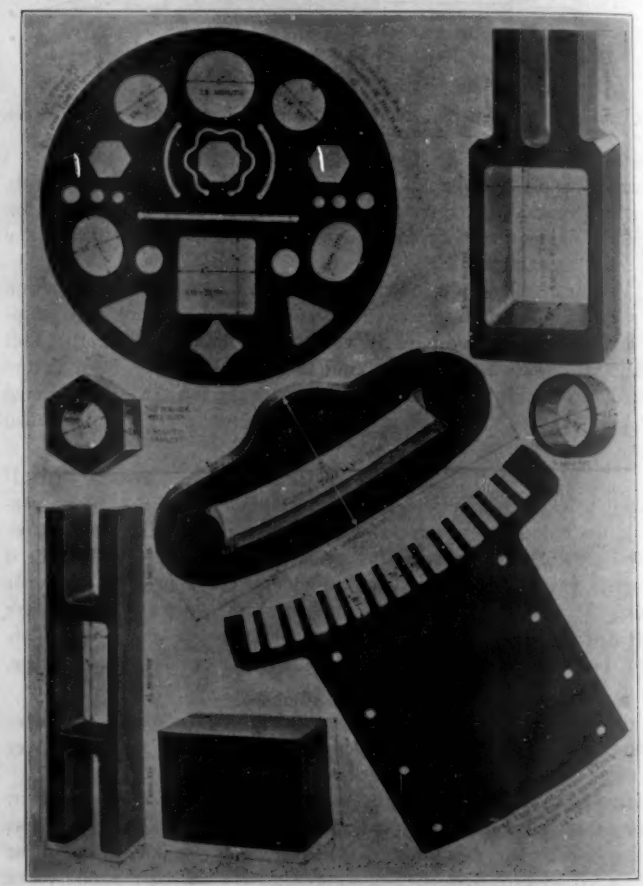
A very prominent space was given over to the display of equipment designed to use the compressed cake form of carbide manufactured by the Carbic Company. Both portable and stationary acetylene generators were shown for welding and cutting. Additional apparatus included welding and cutting torches, regulators, rods, fluxes, and carbic cakes. Equipment for house, automobile, and steamship lighting as well as flarelights and hand lamps were attractively placed.

Consolidated Pneumatic Tool Co., Ltd.

As the name indicates, pneumatic tools are a specialty with this company. In addition, however, arc welding plants, combined portable electric welding and air compressor plants, spot, seam, and butt welding machines were also shown.

Godfrey Engineer Works

The product of this concern is an automatic gas cutting machine which attracted considerable attention. Its property of automatically producing duplicate parts is almost uncanny. The powerful oxy-acetylene flame which, to the casual observer, appears so tiny and gentle, when guided and controlled by Mr. Godfrey's product performs wonderful feats. Cuts can be made to a line, leaving the edges sharp and either perfectly square or at any angle of bevel desired. For circular, straight or square shapes the adjustment requires but a minute or two. When irregular shapes are needed, a thin sheet of wood or fibre is first



A Few Samples of Work That Can Be Reproduced on the Godfrey Cutting Machine.

cut out to the desired shape. A small roller mounted on the end of an arm, following this shape, will duplicate it in steel to such a degree of accuracy that even gear teeth can be cut. A ¼ horsepower electric motor provides ample power.

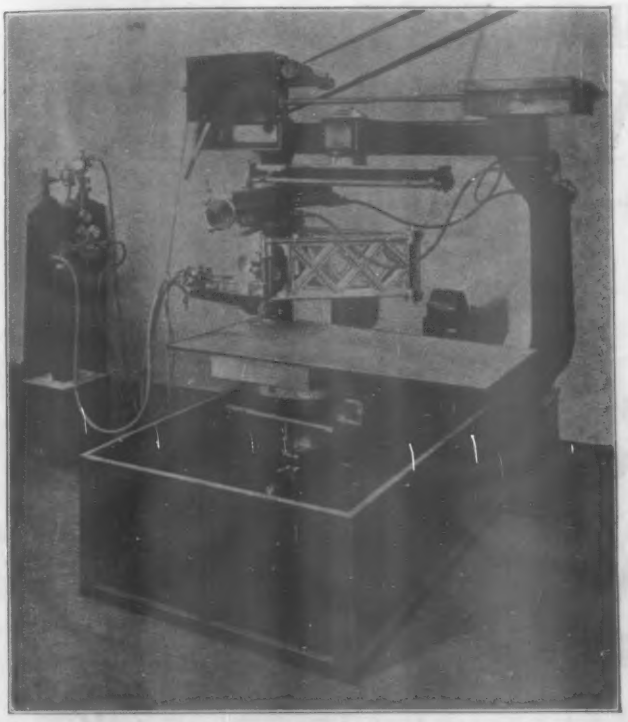
Hydrogen, Oxygen & Plant Co., Ltd.

In addition to welding and cutting equipment, this company featured oxygen and dissolved acetylene and other industrial gases of their manufacture. Oxygen gas generators of the chemical type and chemicals for the purification of acetylene completed the line.

Metallisation, Ltd.

While the apparatus offered by this firm is not, strictly speaking, related to welding or cutting, yet the novel application of

the oxy-acetylene flame invited attention. The process consists of impinging, as a fine spray, metal on any surface to be coated. The apparatus designed to accomplish this purpose is adapted for use either in the shop or out of doors. The spraying gun, which weighs a little more than three pounds, is connected to gas and air supplies. The gas provides the means of combustion, while the air furnishes the motive power for feeding. Oxy-acetylene, oxy-hydrogen, or oxy-city gas may be employed to supply the necessary heat. The metal to be used for coating is automatically drawn from the reel, into the pistol case. It is fed continuously



A New Style of Automatic Cutting Machine Which Attracted Much Interest.

at a speed corresponding to its melting rate, into the nozzle, where it is melted and blown at high velocity, in the form of a fine spray or mist, upon the work to be covered.

Premier Electric Welding Co., Ltd.

The main feature of this exhibit was a multiple arc welding plant. As the name signifies a number of operators can work from the same machine. The prime factor in this machine is the introduction in series with the main generator, of a small dynamo (exciter type—35 volts), which cuts out automatically after the arc is made. By such an arrangement the high starting voltage is supplied and large resistances are eliminated.

Alternating current machines, engine driven portable plants and special flux coated electrodes were employed in giving demonstrations.

G. D. Peters & Co., Ltd.

This company showed the Wilson Plastic Arc Welder in conjunction with other specialties.

Quasi-Arc Co., Ltd.

The current regulators and electrodes employed by this firm's process of electric welding were emphasized in the exhibit. Samples of Quasi-Arc welding which underwent tests by Lloyd's proved interesting as well as the typical joints and construction adopted for fabricating welded ocean going vessels, retort houses, condensers and gasholders of 3,000,000 cubic feet capacity.

Scholey Construction Co., Ltd.

Specially designed electric welding plants and processes were displayed by this company. Demonstrations were also given.

Thorn & Hoddle Acetylene Co., Ltd.

This exhibition may well be divided into two classes: First, the Acetylene Lighting Division and second, the Oxy-Acetylene Welding and Cutting Department.

It is difficult to describe with the written word the perfectly wonderful effects obtained with acetylene as an illuminant. The seemingly "impossible" has been done by this company in its application to fittings. Candelabra, alabaster, bowl pendants, candle fittings, wall brackets, table and even movable floor lamps produced glows which could strictly be called charming.

Then there were stoves, radiators and other heating appliances for using acetylene, also flarelights varying in range up to 5,000 candlepower, and acetylene lighting generators.

A very complete line of welding and cutting apparatus and accessories were demonstrated. Here were shown special welding torches with dual valve controls, cutting torches, tube cutters, pressure regulators, gauges, hydraulic back pressure valves, welding tables, work vises, gas economizers, oxygen cylinder stands, carbide storage drums, asbestos gloves, masks, and goggles, and a range of automatic acetylene generators. The dual control, as the title implies, indicates that the oxygen and acetylene gases in the welding torches are governed by one movement. This control differs from the rather old idea of obtaining like results through the use of a plug valve arrangement, inasmuch as there are two separate and distinct valves employed. These valves are designed so that a single movement causes both valves to func-

A Popular Type of Low-Pressure Acetylene Generator.

tion, first opening the oxygen and then the acetylene passage. The tube cutting torch is specially adapted for boiler work, where the tubes or flues are to be cut internally.

The acetylene generators are called "Incanto." A variation in size and shape for both portable and stationary installations gives a very full range. They are all of the automatic low pressure, water to carbide design. These machines bore evidence that considerable time and attention had been given to their construction. The hydraulic back pressure valves differ from the ordinary in that they have a glass port which reveals to the operator his exact water level.

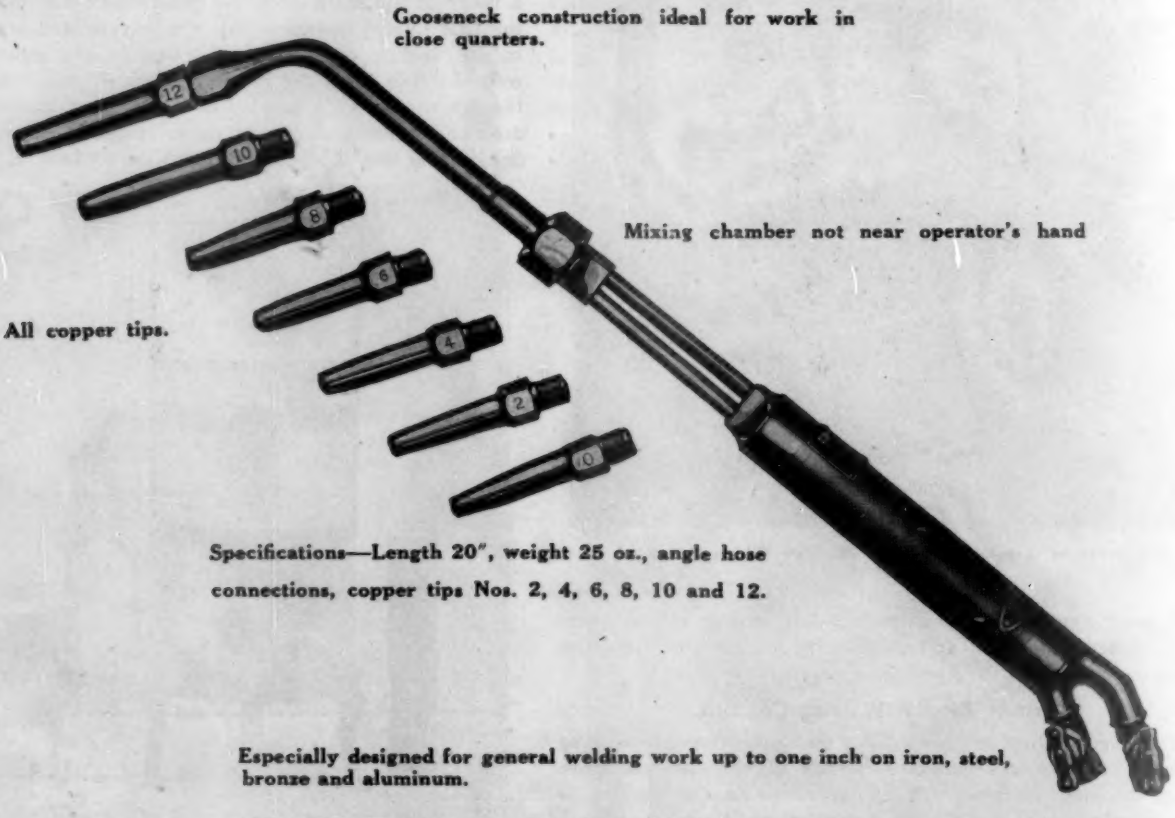
Walker, Crosweller & Co.

The Belgian torches "Neogene" were displayed at this booth. The principal feature consists of a soft copper extension tube upon the end of which the tip is mounted. The flexible nature of this extension is intended to allow the operator an adjustment for every job.

There is no subti

THE NEW REGO
GOOSENECK WELDING TORCH

Gooseneck construction ideal for work in close quarters.



Mixing chamber not near operator's hand

All copper tips.

Specifications—Length 20", weight 25 oz., angle hose connections, copper tips Nos. 2, 4, 6, 8, 10 and 12.

Especially designed for general welding work up to one inch on iron, steel, bronze and aluminum.

Price—Torch with 6 tips, Complete—$27.50.

DOES NOT MIX GASES IN OR NEAR THE OPERATOR'S HAND AS IN THE OTHER TORCHES OF SIMILAR DESIGN.

REGO TRADE MARK

The Bastian-Blessing Co.
Manufacturers of REGO TRADE MARK
127 West Austin Ave.

titute for Safety

REGO GM IS ONE GOOSENECK TORCH IN WHICH THE GASES DO NOT MIX IN OR NEAR THE OPERATOR'S HAND. THIS OBJECTIONABLE FEATURE OF THE ORDINARY GOOSENECK TORCH HAS BEEN ELIMINATED BY REGO ENGINEERS.

CONTAINS ALL THE PATENTED REGO FEATURES PREVENTING BACKFIRE.

ITS GOOSENECK CONSTRUCTION MAKES IT IDEAL FOR PIPE WELDING AND FOR WORK IN CLOSE QUARTERS.

REGO PRINCIPLE OF LOW OXYGEN PRESSURE INSURES LOWEST POSSIBLE GAS COMSUMPTION AND COST.

MIXING CHAMBER NEED NEVER BE CHANGED. DESIGNED SO THAT IT ADJUSTS ITSELF TO EACH TIP FURNISHED.

A STRONG, SIMPLE, PERFECTLY BALANCED TORCH WITH WHICH IT IS POSSIBLE FOR EVEN THE INEXPERIENCED WELDER TO DO GOOD WORK.

WRITE FOR NO. 27 CATALOG ILLUSTRATING OUR COMPLETE LINE OF WELDING AND CUTTING EQUIPMENT.

ssing Company

Quality Equipment

Chicago, Ill., U.S.A.

EFFICIENCY OF ARC WELDING

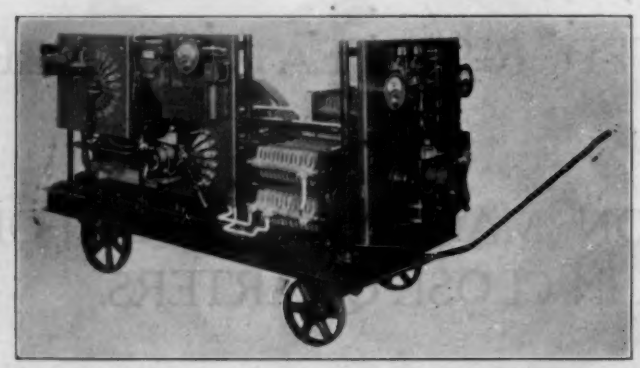
Choosing the Machine for the Work—Selection of Electrodes and Adjusting the Welding Current

By R. D. Reed*

CHOOSING the right size and type of arc welding apparatus is as important to welding as the selection of tools for any other work. The buyer must be careful in his choice if he is to get best results from his outfit. In making his decision, however, he should not be misled by antiquated methods of gauging a welding machine's capacity.

For some time, the operating speed of welding equipments has been given in feet per hour, with the consequence that in certain classes of work or under certain peculiar conditions, an otherwise excellent equipment has suffered from an unfavorable comparison.

Obviously, the number of feet welded in a given time is important only when considered in connection with the nature of



Generator and Welding Panel With Auxiliary Welding Panel and Starting Panel Mounted on Truck With Series Rheostat and D. C. Driven Motor Generator Set.

the work performed, as, for instance, the quantity of metal deposited, the kind of weld required, and the quality of the weld as determined by its ductility, the homogeneity and other physical and metallurgical properties. In comparing the performance of any two equipments, not only should these mechanical conditions be similar but the electrical conditions, the arc voltage and current, should likewise be identical.

Given a definite kind of weld and definite physical properties in the resulting union, the efficiency of any welding apparatus is best gauged by the weight of metal deposited in a given time. In making comparisons of electric welds, however, the size and kind of electrode and the intensity of current employed should also be considered.

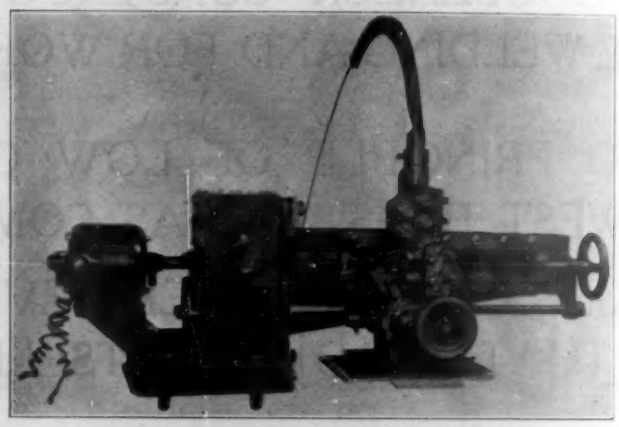
The current intensity employed in arc welding varies somewhat with the class of welding to be performed, the proficiency of the operator, and size and kind of electrodes used. The current values now in favor for metallic electrode welding range from 30 to 300 amperes while the current densities in the electrodes run from 8,000 to 15,000 amperes per square inch.

Welding experience in this country has resulted in selection of equipment on the basis of allowing up to 200 amperes per operator for metallic welding. When carbon welding is to be done the capacity per operator is determined entirely by the character of the material to be welded.

Tests show that better metal is deposited when the arc is kept short and the arc voltage therefore low. Under this condition it has been found that aside from the greater current stability resulting from the higher line voltages, the quality and appearance of a weld are independent of the line voltage employed. With well designed welding apparatus, proper current regulation is largely inherent and it is therefore possible to use low voltages which not only eliminate the likelihood of dangerous shocks to the operator but minimize the electrical losses involved in reducing the line voltage to that actually used in the arc which is ordinarily about 20 volts.

The field in which electric arc welding, cutting and building up metal can be successfully applied, is widening so constantly and rapidly that no list of its many possible uses can be hazarded. It can be generally said, however, that welding is adapted for use whenever steel is to be welded or built up. Some cutting operations are also possible.

Even where welding, building up or cutting metal is conducted only intermittently or on a small scale, the initial cost of an electric welding equipment should not preclude its adoption as even small repair shops have found the use of the electric method to be ultimately the most economical. While such shops form a part of the field for the arc welder, they constitute a minor one when compared with the shipbuilding, locomotive, automobile and other manufacturing industries. In the latter group arc welding effects appreciable economies by permitting the rapid reclamation of worn, broken, or defective castings and machined parts.



Automatic Welding Machine.

Numerous designs of electric are welding equipments have been placed on the market. The greater part of these are for use where electric energy is available. These arc welding equipments, which are designed to meet practically all service requirements, generally fall into one of the following classes:

1. Constant energy type of self-excited generator:
   - (a) Arranged for belt drive.
   - (b) Direct-connected to a direct-current motor for 115, 230, 550-volt circuits.
   - (c) Direct-connected to an alternating-current motor for 110, 220, 440, or 550-volt circuits of any established phase and frequency.
   - (d) For connection to a gas, oil, steam or gasoline engine.
2. Constant potential type of self-excited generator:
   - (a) Belt drive.
   - (b) Direct-connected to a direct-current motor for 115, 230 or 550-volt circuits.
   - (c) Direct-connected to an alternating-current motor for 110, 220, 440, 550 or 2,200-volt circuits of any established phase or frequency.

*Power and Mining Department, General Electric Co.

(d) For direct connection to a gas, oil, steam or gasoline engine.

Because of the various conditions encountered in arc welding, universally applicable data cannot be given. The two following tables give approximations which will, however, serve as a guide.

In general, the most satisfactory welding currents are from 50 to 125 amperes for light work and from 100 to 225 amperes for heavy work. Excessive current causes burnt or porous metal to be deposited. With any given size of electrode, the current used

Automatic Arc Welding of Oil Switch Tanks.

should not, therefore, exceed the maximum value given in the following table:

Metallic Electrodes Diameter in Iuches	Amperes	Corresponding Plate Thickness in Inches
1/16	25-50	Up to 1/8
5/32	50-90	Up to 1/4
1/8	80-150	1/8 to 3/8
5/32	125-200	1/4 up
1/8	175-225	3/8 up

Although the same size of electrode may be used with various thicknesses of plate, larger current is required for the heavier plate in order to secure proper fusion of the metals. The following approximate welding speeds and costs are based on hand-welding with the metallic electrode.

Thickness of plate in inches	Welding speed in feet per hour	Welding cost per foot	Comparative acetylene welding cost per foot
1/16	20	2.12	1.78
1/8	16	3.12	4.66
1/4	10	7.13	13.3
3/8	6.5	12.3	36.1
1/2	4.3	19.8	much higher
3/4	2.0	47.7	much higher
1	1.4	61.3	much higher

The values in the preceding table are based on average figures for material and labor. They will probably vary considerably with the operating conditions and will vary slightly with the type of equipment.

I. A. A. TO MEET IN CHICAGO

The International Acetylene Association has selected the Hotel Sherman, Chicago for its meeting place this Fall. Meetings will be held November 14, 15 and 16. Those who have attended previous meetings of the I. A. A. know that their programs have always been instructive and interesting. It is promised that the program of this year will be no exception, as arrangements have been made to secure some good speakers, who will discuss subjects of interest to all users of acetylene.

Book Reviews

THE WELDING ENCYCLOPEDIA, Third Edition. Compiled and edited by L. B. Mackenzie and H. S. Card of the Editorial Staff of The Welding Engineer.—A reference and instruction book on the theory and practice of all the welding processes. Words, terms and trade names used in welding practice and found in welding literature are arranged alphabetically, and carefully defined. Especially important words and terms are made the subject of complete illustrated treatises. The definitions and discussions comprise what is called the Encyclopedia Section. Then one chapter is devoted to oxy-acetylene welding, electric arc welding, thermit welding and resistance welding. Additional chapters treat separately of boiler welding, pipe welding, tank welding, rail joint welding, taking into account the use of both gas and electric processes. A section devoted to rules and regulations tells how to install and care for welding apparatus, and describes the limitations imposed on the applications of the processes by federal, state and insurance regulations. A special chapter deals with the subject of the heat treatment of steel, and this is followed by a collection of charts and tables of useful welding information. There is a Catalog Section at the end of the volume which illustrates and describes the leading makes of welding apparatus and supplies. A new feature has been added in publishing the Third Edition which gives an entirely new character to the book. This is the chapter on "Training Operators." A complete outline of lessons furnishes the instructor with a logical plan of instruction, and gives a reading reference directing him to the portions of THE WELDING ENCYCLOPEDIA which cover these topics. This is followed by a set of exercises and a set of examinations. Both oxy-acetylene welding and electric arc welding instructions are handled in this manner in the instruction outlines, giving the welding instructor and the welding student an opportunity to get full value from all of the information contained in the text. 437 pages; 600 illustrations; bound in flexible leather grain binding; gilt edges; price, $5.00. Published by The Welding Engineer, 608 S. Dearborn St., Chicago, Ill.

MANUAL OF INSTRUCTION FOR WELDING OPERATORS—This manual contains a complete set of outlines of lessons, exercises and examination for the training of oxy-acetylene welders and electric arc welders. In the outline of lessons a great deal of care has been exercised to provide a logical development of welding instruction, and to give reading references which will enable the instructor and student to secure full information on every topic in the outline. The exercises in each course start with an exercise in setting up the apparatus for welding, and carries the student through the more general operations, then provides special exercises typical of the work done in some of the more important industries which are large users of the welding processes. In the case of each exercise the objective is clearly stated and auxiliary information is supplied covering the important points which might be overlooked by the student in his course of reading. Lessons and exercises are supplemented by lists of general and special examination questions. These questions may be made to serve a threefold purpose. The instructor can use them to determine how much the student has gained from his course of instruction; the employer can use them to determine the ability of the applicant for a welding position, and the welder himself can use them as a check on his own knowledge of the work which he is doing. The manual contains two pages of color charts, one of them illustrating the appearance of metal at varying temperatures and the other showing the proper adjustment of the oxy-acetylene flame. There are also two pages of illustrations showing step by step how to assemble the oxy-acetylene apparatus and get it ready for operation. This little booklet has been prepared for the use of welding instructors, welding foremen, welding supervisors and welding students. It will be sent free to interested parties by THE WELDING ENGINEER, 608 S. Dearborn St., Chicago, Ill.

THE BRITISH ACETYLENE AND WELDING HANDBOOK—This hand book is the outcome of a desire frequently expressed by those interested in the acetylene industry in Great Britain for a compact and convenient volume in which will be set forth all the statutory official regulations and transport conditions, etc., with the addition of a certain amount of technical information relating to acetylene and carbide of calcium. It contains historical notes on carbide of calcium and acetylene by W. J. Atkinson; a treatise on dissolved acetylene by Arthur Stevenson; a treatise on oxygen by C. Coulson Smith; a description of the production of oxygen by the liquid air process; a discussion of the various applications of acetylene by A. G. C. Lacus; a treatise on oxy-acetylene welding and cutting by D. Richardson; a description of tests on mild steel wire by E. A. Atkins; a treatise on acetylene lighting by Alfred Hoddle; a description of the specifications of the various acetylene generators made in Great Britain complete information regarding the British Acetylene and Welding Association; rules and regulations regarding the manufacture, use, storage and transportation of carbide and acetylene, and a list of patents, books and periodicals relating to acetylene and its applications. 384 pages, cloth bound. Price $3.00. Distributed in the United States and Canada by THE WELDING ENGINEER Publishing Company, Chicago, Ill.

FUNDAMENTALS OF WELDING GAS, ARC AND TERMIT. By James W. Owens—Describes in detail the theory and practice of joining metals by the four principal welding processes. The text reflects the experience of the author, who has been engaged for a number of years as a welding expert by the navy department. Table of Contents includes classifications and nomenclature, preparation and finish, gas welding, arc welding, technique of arc welding, thermit welding, gas and arc cutting, metallography of the weld, residual stresses, speed and cost of welding and cutting, choice of methods, design, inspection and testing, production and distribution of oxygen, hydrogen and acetylene, arc welding generators and transformers, welding and cutting machines, welding rods, electrodes and fluxes, protectors and safety precautions, organization shop and school layouts, training, practical gas cutting and welding course, practical arc welding course, standard specifications and practical applications. The volume may well be said to cover the entire range of welding problems encountered in ship construction and repair. 672 pages, 279 illustrations. Keratol binding. Costs $10.00. Published by Penton Publishing Co., Cleveland, Ohio. May be secured from THE WELDING ENGINEER, Chicago.

The Welding Engineer

Reg. U. S. Pat. Office.
Published on the 17th of Each Month by

THE WELDING ENGINEER PUBLISHING CO.,
608 S. Dearborn St., Chicago, Ill.
Telephone Wabash 7134.

L. B. Mackenzie.....President and Editor
H. S. Card.....Associate Editor
R. L. Miles.....Associate Editor
W. W. Brothers.....Associate Editor

Subscription payable in advance and postage free.
United States and possessions and Canada .....$3 a year
Foreign Countries .....$4 a year
Single copy, domestic .....25 cents
Single copy, foreign .....30 cents

Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

The Welding Engineer is a member of the Audit Bureau of Circulations and of the Associated Business Papers, Inc.

Last Advertising forms close at 8:00 a. m. on the 15th. To show proof for correction copy must be received at an earlier date and allowances should be made for delay to mails.

The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

The Welding Engineer in Great Britain

Capt. D. Richardson, Northampton Polytechnic Institute, Clerkewell, London, E. C. 1, England, is our accredited representative in Great Britain for obtaining new subscriptions to The Welding Engineer and The Welding Encyclopedia.

The Welding Engineer in Australia and New Zealand.

Mr. R. Hill, Matlock House, Devonport, Auckland, New Zealand, is our accredited representative in Australia and New Zealand for obtaining new subscriptions.

VOLUME 8 OCTOBER, 1923 NUMBER 10

CONTENTS FOR OCTOBER

Metallography and Testing of Oxy-Acetylene Welds....19
British Welding Exhibition....23
Efficiency of Arc Welding....28
Book Reviews....29
Editorials....30
Welding Aluminum Cases....32
Removing Pin from Striking Block....36
Repairing a Broken Pulley....36
Flange Welded Tanks....40
Welding Society Meets in Pittsburgh....44
News of the Welding Trade....46
Prof. Thomson Tells Story of Resistance Welding....47
Specially Wound Grinder Proves Great Convenience....47
Current Welding Literature....48

Better Welding Exhibits

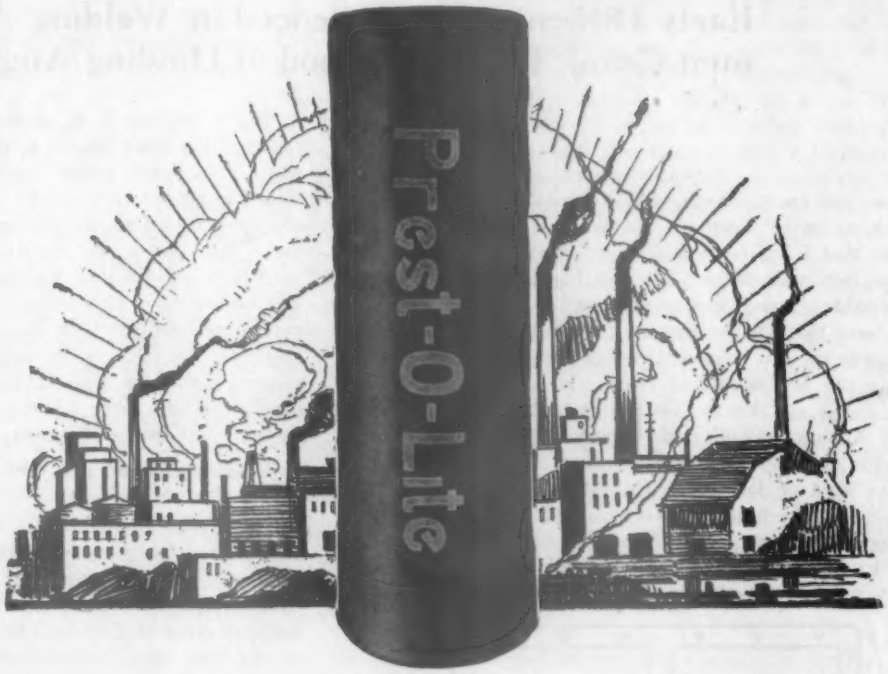
ALTHOUGH American manufacturers of welding equipment can well claim to lead the world in the production of efficient apparatus and appliances, and although the industry is supported by several very strong national organizations, it is very seldom that the booths of exhibitors of welding equipment in our industrial expositions make as good a showing as the exhibitors of similar products in the leading European centers. This is not due to lack of individual attention, because many of our large expositions have been the occasion of splendid demonstration of the possibilities of welding. The trouble has been that the exhibits have been so scattered and mixed with a big variety of machinery and metal working devices, that welding showed up here and there as an incidental feature. If some arrangement could be made to bring all of the welding exhibits together in a group or section, thus offering to the exhibitors an extra incentive to make the individual booths attractive and instructive, the importance of welding as a process would be greatly emphasized; at the same time, each exhibitor would get some of the benefit of the work of all the other exhibitors who displayed their equipment.

Testing Welds in the Shop

EXPERIENCED foremen and supervisors know that it is not necessary to have elaborate laboratory equipment to test the skill and ability of the ordinary welder. For the general run of work, a sample weld on a test piece will show whether the operator knows how to fuse his metal properly or not. If the test piece is made large enough so that it can be cut into sections to permit a bending test, a cutting of a section across the weld, and a cutting of a section through the center of the weld, these three pieces will give a lot of information regarding the way the work was done. The trouble is that very often the welder whose work is not up to standard does not know exactly how the finished job should appear. It has been suggested therefore that in every shop where tests of this sort are made, sample pieces should be welded correctly, bent in a vise and cut across and through the deposited metal; that these pieces be varnished to prevent oxidation, and mounted where they can be examined conveniently. Then the welder can work on his test piece, make his own tests and compare them with the perfect specimen. If there are any defects, the opportunity for direct comparison gives the supervisor an excellent chance to explain just what was wrong with the operation.

What the Figures Fail to Show

EVERY once in a while a group of investigators succeeds in establishing the fact that the number of failures in welded boilers is on the increase. The reason seems to be the same as the reason why white sheep eat more than black sheep—because there are more of them. The men who have the interest of better welding at heart are tireless in their efforts to regulate welding practice so as to reduce the number of failures, and they are getting good results, but boiler explosions are not altogether up to the welder. The roundhouse foreman who is asleep on the job when he should be maintaining the proper water level is responsible for a goodly portion of these mishaps. So is the foreman who refuses to take the advice from someone who really knows something about welding, and persists in turning over the torch or the arc to the tender mercies of an ignorant laborer with the comment that "anybody can weld". There are so many ways to do a poor job of riveting that it would be a shame to allow the impression that riveting can be considered as a safer method of making joints.



Meeting the Demand

To meet the constantly growing demand for Prest-O-Lite service, Prest-O-Lite's cylinder factory is distributing an ever-increasing number of new cylinders.

Years of experience in the manufacture and distribution of Dissolved Acetylene has established a high standard for every Prest-O-Lite cylinder—a standard that Prest-O-Lite unfailingly maintains by making its cylinders to its own design and under its careful supervision.

An inquiry at our nearest sales office will bring you information concerning our latest sales and service plans.

Each Prest-O-Lite user looks to his nearest District Sales Office not merely for arrangements to adequately cover acetylene needs, but for helpful co-operation and advice on any matter involved in the use of acetylene.

THE PREST-O-LITE COMPANY, INC.

General Offices: Carbide and Carbon Bldg., 30 E. 42nd St., New York City

In Canada: Prest-O-Lite Co. of Canada, Toronto

District Sales Offices

Atlanta	Chicago	Detroit	New Orleans	Pittsburgh
Baltimore	Cleveland	Kansas City	New York	San Francisco
Boston	Dallas	Los Angeles	Philadelphia	Seattle
Buffalo		Milwaukee		St. Louis

Prest-O-Lite

DISSOLVED ACETYLENE

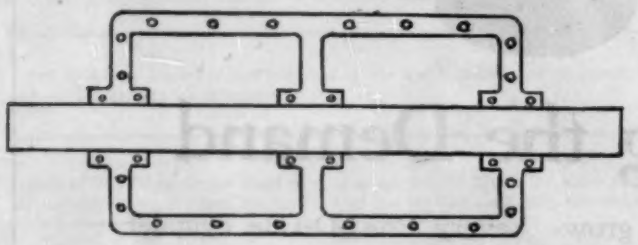
WELDING ALUMINUM CASES

Early Difficulties Experienced in Welding Aluminum Crank Cases—Method of Holding Alignment

At Sea,
Tuesday.

Dear Ed:

I suppose you are wondering why I haven't written you in the last month or two. Truth is, things have been happening so dogone fast that I had no time for anything. Was going to drop you a line last week before I sailed, but decided to wait and see if everything turned out as planned. Suppose you are surprised to learn that I'm on my way to Europe, or perhaps nothing I do surprises you any more, seeing the jumping around I've been doing the last couple of years. Here's the way it happened, Ed: As you know I've always had a hankering to go across the Atlantic. Well, a rare opportunity was presented, so I handed the boss my resignation, worked like a goodfellow for ten days to wind up the loose ends, then hopped down to Montreal and caught my boat. Betwixt me and thee I'm getting the best passage on the ship for almost a song, that's the reason. What am I going to do in Europe, you ask? The answer is easy,



Illustrating How Steel Shaft Is Fitted to Preserve Alignment of Bearings in Aluminum Crank Case.

simply loaf. I have a bit of cash saved up and with the foreign exchange as it is, I can live like a king for some time to come, and in the meantime, methinks I'll knock around a bit and see what the Europeans are doing in the way of welding. You may be sure if there is anything interesting comes up, I'll pass it along.

By the way, having a day to spare in Montreal I looked in several of the shops and came across one mighty good stunt that I know will interest you. This happened in one of the oldest and largest shops there. After going through the shop we returned to the office and were going over some photos of the most important jobs which had been handled. There was the usual run of welding, brazing, and cutting jobs, all of which had been done in the regular way. The talk turned to aluminum, so more photographs were produced. This is the story as received.

"Yes sir, we are turning out some wonderful work on aluminum now, but such was not always the case. I well remember the first job of this kind that we received. It was years ago but stands out like a milestone in my memory. The job was not a very difficult one, to all appearances; simply a broken arm on a crank case. The break itself was at some distance from the body of the case and nowadays it would be about the easiest thing we could think of. But not so then. The case was nicely set up and the fractured arm held in position all ready for welding. Knowing that aluminum melted at a much lower temperature than cast iron and steel, we put on a smaller sized tip in the torch and started in. You can readily appreciate just how far we got. We couldn't get enough heat to even "tack" the broken arm in place. We had forgotten all about the one thing aluminum as a metal is noted for, namely:—its heat conductivity."

"I imagine that many other welders have been tricked in much the same fashion," I suggested.

"Right you are," he answered, "but let me continue. We changed the small tip for a size larger, with much the same result. Then a still larger size was used but the conductivity continued to get the better of us. In desperation, more than anything else, we decided to use the largest tip we had. By the way, in those days that meant about the average size nowadays. Well, we finally got the stuff melting, but only on the small piece that was broken off. This melted and made a big hole but the crank case proper refused to melt. By this time you can well imagine just how we felt. After getting our heads together we finally concluded that the conductivity of the metal was our enemy and some steps had to be taken to overcome the dissipation of heat through that channel if we expected to make any progress."

"What course did you decide upon?" I asked, seeing he hesitated a minute.

"I was just coming to that," he replied. "We took some sheet iron pieces that were lying about the shop and built a sort of stove-like arrangement around the whole case. We left a small piece covering the place just above where our weld was to be made, in order that it could be moved without disturbing the rest of the oven when sufficient heat had been introduced. Never thinking at the time that the charcoal we had decided to use could be fired with the torch flame, we carefully put in some paper, then a few dry shavings and after that the charcoal. We lit the paper with a match, closed the top part of our oven and watched the smoke." Here he burst out laughing. "I can see those clouds of smoke yet. They simply rolled out and so did we. As you can understand, this didn't tend to sweeten our dispositions any."

"After ten minutes or so," he continued, "the air cleared a bit and we ventured back in the shop. The fire was going nicely so we lost no time in getting to work. The goggles were donned; the small covering on the top was taken off the oven and the big tip was left in the torch. This time there was plenty of heat —in fact too much. The metal melted and receded from the force of the flame so quickly that work had to be stopped long enough to change tips. With the smaller flame everything went along fine. Considerable trouble resulted from the sides sagging, but by turning the torch so that the heat was given off by the side of the flame, instead of the point, this was overcome. Working like Trojans, stirring the two sides together and building up as best we could, the weld was pronounced finished. We replaced the lid and waited for the case to cool down. When six o'clock rolled around it was still too hot to touch so we went home and returned about eight-thirty. As you may suppose, we were vastly concerned over this job so could not sleep until we knew the outcome. By nine-thirty we decided to risk it so the oven was removed and the case given the 'once over.' We tapped the welded arm gently with a hammer. The ring, if it might be called such, was true so we became a bit more strenuous. Sure enough the weld was sound and, although there were huge gobs of metal which had dripped through on the under side of the arm, and the weld itself was a bit rough, yet, taken as a whole it wasn't a half bad job."

"No doubt you felt as happy as a couple of school kids," I volunteered.

"That was the whole trouble, right there," he went on. "If that job hadn't turned out so good things might have been different. As it was, we went home that night patting ourselves on the back, feeling that we had conquered aluminum with one stroke; that we knew all there was to know about it and that it was after all about the easiest of all metals to weld. This opinion was not weakened any on the following day when the owner called for his case and after assembling informed us that

it went together like a new one. You couldn't have touched us with ten foot poles. It was really too bad."

"How come?" I asked.

"Simply this: We were too sure of our own ability and it didn't take us awfully long to find out how little we really did know about aluminum. To sum the thing up in a nutshell, we had over-advertised."

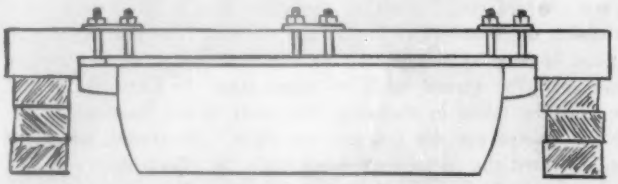
"You don't mean to say that you deliberately advertised in cold print the fact that you could weld aluminum after just one attempt?" I commented.

"Well not exactly, that," he answered, "but it was just as bad. They say 'the pen is mightier than the sword,' but on some occasions the spoken word carries much more weight than the written. This was one instance. We shouted about it so much the next day, that late in the afternoon, Lo and Behold! another case was brought to us and the following morning, still another. Business was certainly booming. The first one was, to all intents and purposes, the same job as the crank case we had such good success with. The arm was broken in very nearly the same place, that being the weak point in that particular case. We set about welding it in the same manner as the previous one. We were very careful for we knew our reputation was at stake. The only changes we made in our set-up were to cut a small piece of sheet iron to put inside the arm and substitute loose bricks for the side of our oven in place of the metal. Our reason for using the iron to back-up our weld was to prevent the weld sagging and the metal dripping as it did in the first instance. Having received several burns from contact with the hot sides of our metal oven during our first experience, we figured that loose fire-bricks built up one on top of another, would be much more satisfactory. With the bricks laid on their flat sides and over-lapping each other, building fashion, there would be much less chance of collapse. Lady Luck smiled again that day. The procedure was much the same as before, smoke and all, excepting the weld itself was made much quicker and far easier with the iron backing which we had provided. As before, it was too hot to remove that night at closing time so we returned later and found that this weld was a much better looking and a neater job than our first one. This only confirmed the good opinion we had of ourselves. Really there wasn't much about the welding of aluminum that we didn't know or rather thought we knew."

"So much for that," he continued. "The following morning we started in on the third case, which was a much different problem than the previous two. It had a hole and bad crack right in the middle of one side, just in line with the center bearing. Apparently the connection rod had come loose and caused the damage. We went after this job without the slightest hesitation. The case was set-up on the welding table; a piece of sheet iron cut and fitted to form a backing for the hole and crack, and held in position by a brick. The oven was built as before, excepting small spaces were left between the lower layer of bricks for draft purposes. We figured that this ought to eliminate much of the smoke. Everything sailed along fine, there was much less smoke and the weld was finished in a very short time. While waiting for the fire to die down and allow the case to cool, we found no trouble in again convincing ourselves that aluminum was the easiest of all metals to weld. Around four oclock that afternoon the fire had died down but the case was still pretty warm. To hasten matters we removed the sheet iron pieces we were using to cover the oven and also some of the bricks forming the sides. In another half hour it was cool. We were well pleased with the weld and so was the customer when he received it. The mutual pleasant feeling was changed a bit when a half an hour later the case was returned with the crank shaft. The case had warped to such an extent that the bearings were fully a quarter of an inch out of alignment. The top and bottom surfaces were perfectly flat, but evidently the contraction of the metal used in the weld was what caused the trouble. It was then that we conceded that there might be one or two points that we could learn further about aluminum and its characteristics for this was something we hadn't foreseen."

"I guess its a pretty tricky metal taken as a whole," I said.

"You are right, only we were inexperienced and didn't realize it. Something had to be done about this case," he went on, "for it was the property of one of our very best customers. We got our heads together and decided we must first learn what the cause of the warping was before a means of overcoming the trouble could be located. The more we thought of it, the more convinced we became that the drafts of cold air striking the hot case when we uncovered it and tried to rush it through was the real reason. We analyzed it still further by saying that inasmuch as the welded side was the hottest; that was why more contraction occurred on that side than the other. Thinking we realized what the cause was, the next thing was to correct the error. This almost proved our undoing but finally we concluded that if the weld were undone a new start could be made with better results. Accordingly a hack saw did the unwelding stunt. The



Showing How Steel Aligning Shaft Is Supported When Welding Aluminum Crank Case.

two edges were separated and sure enough the bearings lined up fine."

"To prevent a repetition of what transpired just previously we decided that we would try three new things this time. First, we would wedge open the break a little to allow for some contraction. Second, in order to equalize the heat after welding, more charcoal would be added immediately after the weld was finished and the oven covered up. Third, that the case would remain as previously in the oven, but would be kept there entirely covered up, until absolutely cold. The weld proceeded as scheduled. After the weld was made, the additional charcoal was added and the oven cover replaced. Oh, it is a sad story! The next morning when we looked in the oven for our case with a great deal of expectancy, it wasn't there. It had disappeared entirely, I mean that literally. There were large pools of solidified aluminum mixed with the ashes but the case was gone. The air became 'blue' and we concluded then and there that there was much more to aluminum and its handling than we ever supposed."

"But what became of the case?" I asked.

"The thing melted. When aluminum is heated and the melting point is reached it looses all its strength and collapses. The answer was easy for us after the damage was done. We had added too much charcoal after our welding operation. The case was already very hot and it didn't require much more heat to turn the trick."

"Whoops, my dear! I've heard of arms and various parts melting off, but never an entire case. That left you in a fine pickle. What kind of an explanation did you give your customer?"

"Oh! That's a deep secret, but I'll tell it to you. We had boasted so much, that we felt that our reputation was at stake. If knowledge of our carelessness became known we would never hear the end of it. So we hied ourselves to quarters and another used case of the same model became our property. After a few passes of the welding torch, our customer received 'his' case and was so pleased at the perfect bearing alignment that his praises were broadcast in every direction."

"All of which proves that its not the actual profit on each job as much as the good will of your trade that proves the most profitable in the long run," I commented.

Well, Ed, the foregoing doesn't reveal the principal "stunt" I told you about, but it shows what this fellow was up against;

how he started at the bottom without instructions and simply used his head. I imagine there are a lot of lads in the same position only he was the first one to come across clean, and admit his shortcomings.

It was here that I took occasion to ask him what, in his opinion, was the most difficult every-day problem that confronts the welder of aluminum and the means he advised for procedure.

"That is rather a broad question you ask, but I don't think I'll have to hesitate very long in answering," he said. "I believe the preservation of alignment in the ordinary crack case, especially if the weld is anywhere near a bearing, is the most difficult problem. There may be exceptions, but taken as a whole they are hard to beat. When it comes to a solution of this difficulty much can be said, I'll have to sum it up rather hurriedly because I didn't realize it was getting so late. I have an engagement in fifteen minutes; I'm awfully sorry.

"But to save the alignment I've found the best way is to find a piece of cold rolled shafting the same size as the crank shaft and clamp the bearings to it. If the shafting isn't the exact size, no good is done by this procedure. If it is too large in diameter it can easily be turned down to exact size. In addition to this, care must be taken in clamping the shaft to the bearings to see that the clamps are not screwed too tight. Otherwise, when the case is heated the metal in contact with the clamp may collapse. Further than this, this shafting, which generally turns out to be quite heavy, must be supported in such a manner to keep the weight off the case. This can usually be accomplished by putting supports at each end and then blocking up underneath the case at as many points as possible. When this is done, preheating or anything else can be done and the steel shaft will be found heavy enough to serve the purpose intended.

"Now if there is anything I haven't made clear, just let me know or drop me a line. I'm sorry but I'll have to run now."

It was too bad that time was an element and his description had to be so brief, but no doubt you'll get the gist. There were many other questions I really wanted to ask but you see how it was.

Well, Ed, we won't see France for two or three more days and there is much I'd like to tell you about the trip so far. How the sea, last night, got so rough that we were knocked around like a peanut shell; how half the passengers are so seasick that one minute they're afraid they're going to die and the next minute, they're afraid they won't; about the tennis matches, shuffle board, rope skipping, salt baths, and concerts on board, but really, Old Boy, I'll have to ring off now as I'll get writer's cramp if I don't. On to Paris, I'll drop you a line from there.

As ever, yours, SHEP.

NEW BUILDING FOR BASTIAN-BLESSING CO.

The Bastian-Blessing Company, 125 West Austin Avenue, Chicago, announce the purchase of a new building on Ontario Street, two blocks east of Michigan Boulevard, Chicago. The

The New Home of The Bastian-Blessing Company.

purchase is the result of a demand for increased production facilities.

The new building is bounded on two sides by streets and on the other two sides by private courts, insuring permanent light from all sides. The gross floor area is about 100,000 square feet. On or about December first the Bastian-Blessing Company will occupy their new quarters, abandoning the old building, but continuing the operation of their Grand Haven plant where a line of complete soda fountains is manufactured.

E. N. KREIN CAPTURES GOLF TROPHY

The beautiful silver trophy offered by *The Welding Engineer* for the series of golf tournaments which started on August 7th was won in final play Wednesday, Sept. 19th, by E. N. Krein, of the Bastian Blessing Company, Chicago.

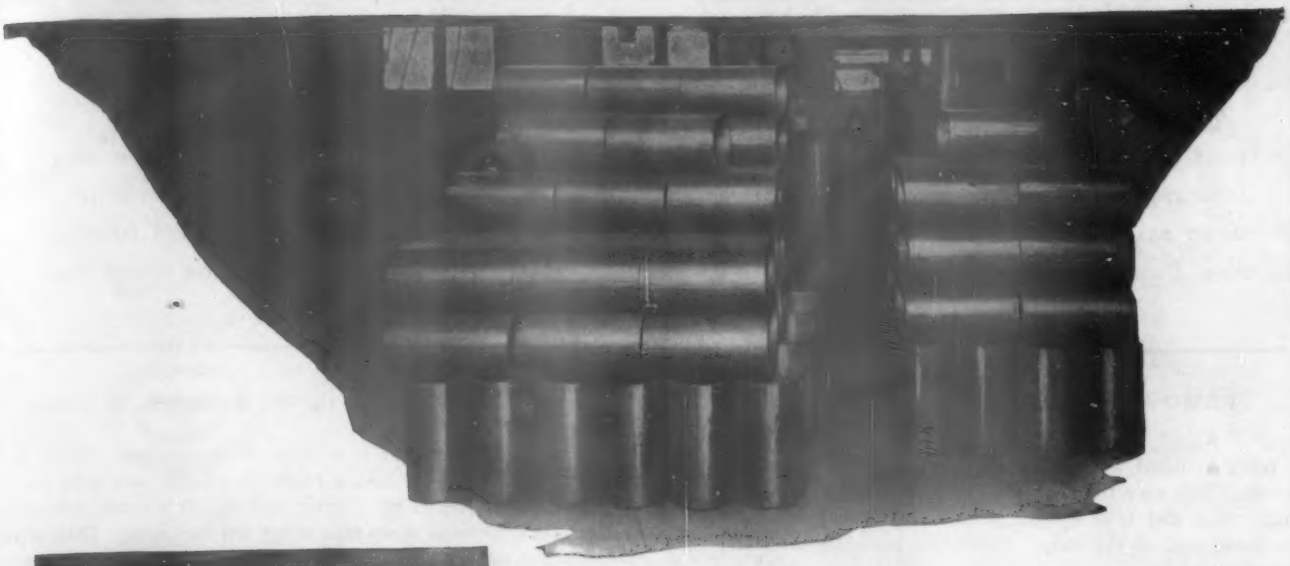
The interest displayed in the golf tournament which was arranged as part of the program of the 1923 summer convention of the Gas Products Association had prompted some of the more enthusiastic golfers in this busy group to take a half day off now and then through the summer and get together for a little more competition. In order to put a little keener edge on this competition, *The Welding Engineer* donated the loving cup illustrated here for the best low net score. E. A. Faulhaber of the

Krein's 92 Put This Trophy on Ice.

Burdett Company has been the leading spirit of these gatherings and has gone to considerable trouble to make arrangement for reservations at the Wheaton Green Valley Golf Club, providing for some specially good dinners at the close of each play and keeping order generally. Mr. Faulhaber claims that the only scandal connected to this series of meetings is the fact that he did not win the cup.

Mr. Krein's victory was well deserved. With a handicap of four, he turned in a score of 92, which was the lowest gross score of the day. For a golfer who has only been following the sport three years, this is a very creditable showing.

The members of the Gas Products Association have so thoroughly enjoyed these half-day outings that it is planned to continue them in the future. They offer an excellent form of recreation and an opportunity for competitors to get together and enjoy one anothers society in an informal way.



Straight seam welding of tanks by G-E Automatic Arc Welder.

Building up shaft by G-E Automatic Arc Welder.

Automatic Arc Welding

The above picture shows 50 tanks welded by a G-E Automatic Arc Welder in a half day, as compared to 21 tanks welded by the hand method in a full day. The metal welded is 1/8" thick by 24" long.

Through this automatic application of the electric arc, a steadiness of the electrical conditions in the arc is obtained and maintained, resulting in a uniform and high quality of weld—and higher speed. Higher welding speeds produce lower welding costs.

The principal field for the G-E Automatic Arc Welder is the production, by welding, of duplicate objects in considerable quantities.

Its greatest use is for straight line seam, which is the simplest form of weld—but it also does efficient welding of circular seams, and in building up processes on metal.

G-E welding engineers will cooperate with you in making suitable applications of the Automatic Arc Welder to processes of production in your plant. Ask them.

General Electric Company
Schenectady, N. Y.
Sales Offices in all Large Cities

GENERAL ELECTRIC

43B-20

Hints for the Welder

When you finish an interesting piece of work, can you set down on paper the manner in which you went about the job, how you prepared the work and how the job was done? Have you learned some little stunt every welder ought to know? Contributions to this department are paid for. Write it down any old way – I'll polish it up. Make a rough pencil sketch and our draughtsman will fix it up fine. Line drawings are more practical than photographs. Do it today – the men on the firing line are waiting. L. B. Mackenzie, Editor.

REMOVING PIN FROM STRIKING BLOCK

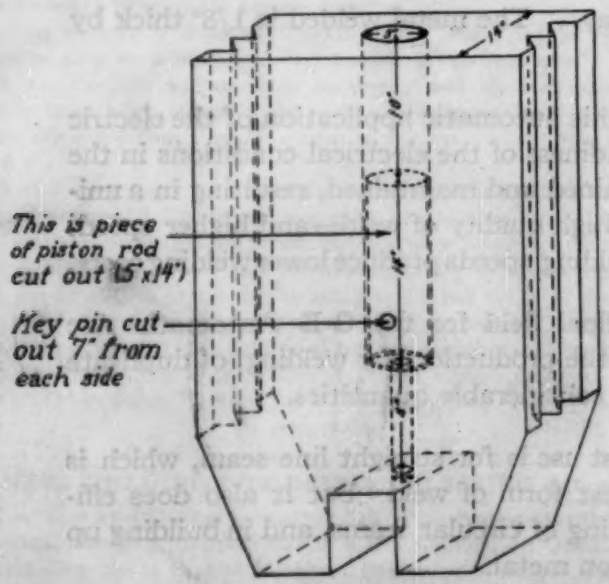
By R. P. Palmer

Well, as usual when a breakdown occurs, the welder is summoned. This time the shop superintendent said, "Go to the blacksmith shop and take a look at the steam hammer, the one in the south end of the shop. After you have made an inspection please report to me."

Arriving at the shop I found the steam hammer piston rod was broken ten inches inside of the striking block.

After looking the job over I went to the superintendent's office and he asked me if it could be welded. I told him that I had welded similar jobs, but the cylinder and striking block would have to be removed, as I could not get at both sides any other way.

He informed me that if the cylinder and striking block had to



Cutting Job Accomplished by Using Both Oxygen and Electric Arc.

be removed to weld the rod, they would put on a new rod. I told him I thought a new rod would be best, and started to leave when he said, "How are we going to get the end of that piston out of that striking block?"

I told him that cutting by oxy-acetylene was out of the question.

Several hours later the general foreman came to me and said, "We are up against it, I guess, because there are fourteen inches of that piston rod in the striking block. Of course I think we could get it out, but it would be quite a job, as it would be necessary to drill the key pin out, and that is fourteen inches long, but after we get that pin out the end of the piston will still be tight, because it is a shrunk fit, and if we heat the block the piston will get hot also. So that method is eliminated, and to be honest about it we haven't a machine suitable to bore out that piece of piston."

He said, "How about that rig that the cutters use to burn out main pins with?"

This rig he speaks of is a piece of oxygen hose with a tank connection on one end and a piece of quarter inch pipe on the other. On the end of the quarter inch pipe is a union, into which we screw a piece of scrap pipe about ten feet long. Then taking the cutting torch we heat a small spot in the center of the main pin, turn on the oxygen in the pipe and in less than a minute there is a hole through the pin.

After putting a hole in the pin it is easy to remove by aid of the cutting torch.

I told the general foreman that this could be used if we had some way of heating a spot on the end of the piston, but one could not get a torch into the hole on either end, one end being five inches, the other two inches.

A few minutes after the general foreman had left I began experimenting and the experiment worked. So I told the smith shop foreman to send the striking block to the welding shop.

I had a cutter get a full tank of oxygen and get the cutting pipe ready, also had one of the electric welders run a ground wire outside of the shop and connect the welding cable when the block arrived. We placed the ground wire on the block, turned on a little oxygen, placed the electrode holder on the pipe, put the pipe in the four-inch hole in the block, then when the pipe touched the end of the piston it struck an arc making a small spot. The oxygen started cutting immediately, so we increased the flow of oxygen a little and in slightly less than two minutes a hole was through the piston.

After completing the first hole it was easy to cut the sides and remove the pin in two pieces.

REPAIRING A BROKEN PULLEY

By W. J. Field

Sometime ago the employes of a railway company, while unloading a pulley 6 ft. 6 in. in diameter and 2 ft. wide, allowed it to drop a short distance on soft ground, thinking it would not be damaged. Upon examination by the owner the pulley was found to have a fracture extending from arm to arm on the rim

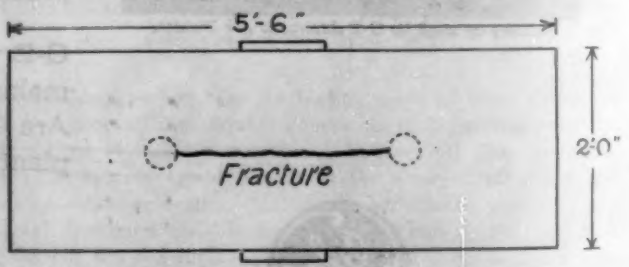


FIG. 1

as shown in Figure 1. The owner refused to accept the pulley in this condition so it was up to the railroad company to make good the damage by either supplying a new pulley or repairing the damaged one well enough to make it acceptable to the owner. I was asked to undertake this weld, and since it turned out to be

ELECTRIC "RACO" OXY-ACETYLENE

MILD STEEL and IRON WELDING WIRES

"RACO" BLUE LABEL

Analysis:

Carbon	not more than 0.18%
Manganese	not more than 0.60%
Phosphorus	not more than 0.025%
Sulphur	not more than 0.04%
Silicon	not more than Trace

This wire is admirably suited for all general repair and production work. For welding mild steel, structural shapes, plates, bars or low carbon steel forgings and castings. It is unusually smooth in finish and free from any trace of grease or rust.

The steel from which "Raco" Electric Welding Wire is manufactured is made by the basic open hearth process and the wire is drawn with great care to insure evenness in structure.

"RACO" WHITE LABEL

Analysis:

Carbon	not more than 0.06%
Manganese	not more than 0.30%
Phosphorus	not more than 0.02%
Sulphur	not more than 0.04%
Silicon	not more than Trace

This wire may be used with success wherever imported Norwegian or Swedish wire has been considered necessary.

"RACO" COVERED YELLOW LABEL

Analysis:

Carbon	not more than 0.18%
Manganese	not more than 0.60%
Phosphorus	not more than 0.025%
Sulphur	not more than 0.04%
Silicon	not more than Trace

"RACO" Covered Electrodes are used with either alternating or direct current where bare wires will not give satisfactory results.

"RACO" HIGH CARBON

Analysis:

Carbon	0.85-1.10%
Manganese	0.30-0.60%
Phosphorus	not more than 0.04%
Sulphur	not more than 0.04%
Silicon	not more than 0.04%

for welding with direct current high carbon steel and worn surfaces where great resistance to abrasive wear is desired such as rails, frogs, switch points, bearing surfaces, etc.

"RACO" HIGH CARBON COVERED

Analysis:

Carbon	0.85-1.10%
Manganese	0.30-0.60%
Phosphorus	not more than 0.04%
Sulphur	not more than 0.04%
Silicon	not more than 0.04%

for welding with alternating current high carbon steel and worn surfaces where great resistance to abrasive wear is desired, such as rails, frogs, switch points, bearing surfaces, etc. This wire is manufactured especially to conform to specifications E-No. 1C of the AMERICAN WELDING SOCIETY.

"RACO" RED LABEL

Analysis:

Carbon	not more than 0.06%
Manganese	not more than 0.30%
Phosphorus	not more than 0.02%
Sulphur	not more than 0.04%
Silicon	not more than Trace

"RACO" MILD STEEL RODS FOR OXY-ACETYLENE WELDING
Copper Coated

Answers the usual railroad, shipyard and industrial requirements as are allowed by authoritative regulating bodies such as the American Bureau of Shipping, the Interstate Commerce Commission, etc.

Colored labels in this style identify each different kind of RACO WIRE.

The Reid-Avery Company produces "Raco" Welding Wires *only*. It has no other welding interests. This fact in itself is a guarantee of quality and satisfactory service.

The analyses presented here, and which may be thoroughly depended upon, make it possible to standardize on one or two wires for all, or practically all, uses.

Each package bears a tag plainly indicating customer's requisition and order numbers as well as grade and size of wire.

Inspection may be made either at our plant or at destination as may be most convenient.

"Raco" Wires are uniformly well finished—bare wires are smooth and absolutely free from grease or rust. Coverings, where used, are carefully baked on to insure permanency.

Samples for testing and descriptive booklet sent promptly

REID-AVERY COMPANY

(INCORPORATED)

21st STREET AND WASHINGTON AVENUE

PHILADELPHIA, PA.

Just off the press!

THE WELDING ENCYCLOPEDIA

Third Edition

The only book that covers COMPLETELY all branches of the art of welding

No matter how much welding you do—

No matter what kind of welding you do—

No matter what welding process you use—

If you Weld, you need this book

THE WELDING ENCYCLOPEDIA, Third Edition, *is the most complete book of welding information that has ever been published*

It serves every possible need for information on all of the welding processes. Whether your shop is engaged in production welding or repair welding, or both, whether you use the processes for only one metal or for a variety of different metals and different types of joints, **The Welding Encyclopedia** furnishes you with expert advice which pays for itself by increasing the quality of your work. **The Welding Encyclopedia** is not restricted to the welding knowledge that can be imparted by a single writer. On the contrary, each subject is discussed by a recognized authority on that particular subject. About fifty of the best known authorities on welding subjects in the world have contributed the results of their experience and research along special lines.

In compiling **The Welding Encyclopedia** the editors have had put at their disposal a vast fund of information which could not be made available through any other source. The result is a single volume covering the entire range of problems which can arise in the application of any of the welding processes, and this information has been so carefully arranged and cross-indexed that any portion of it is instantly located.

The Welding Encyclopedia describes in detail the theory and practice of every welding process, and tells how to weld every weldable metal by each of these processes, giving detailed instructions for handling such important welding jobs as boiler welding, sheet metal welding, tank welding, pipe welding, automobile welding, cutting, rail joint welding, railroad welding, etc.

It tells how to prepare parts for welding, how to preheat, how to anneal, how to test welds and how to select welding material. It explains the meaning of all words and terms found in welding literature. It gives the trade names of all products used in the welding industry, giving the name and address of the manufacturer in each case.

It tells how to take care of welding equipment so as to get the best results from it and keep maintenance costs down. It gives the federal, state and insurance rules and regulations for the installation of welding equipment, and its application to important work. There is also a splendid collection of charts and tables used for welding information, grouped together for convenient reference.

A new and valuable feature which has been added in publishing the Third Edition is a complete chapter on the training of operators. This chapter outlines lessons, exercises and examinations for a complete course in both oxy-acetylene and electric arc welding. Throughout these instruction courses references are supplied to the instructor and student so that they may find instantly the portions of the text which cover the topics in the outline.

The text is profusely illustrated with photographs and drawings made especially for **The Welding Encyclopedia**. No detail has been overlooked which could make **The Welding Encyclopedia** complete and practical.

THE WELDING ENCYCLOPEDIA
gives you the answers

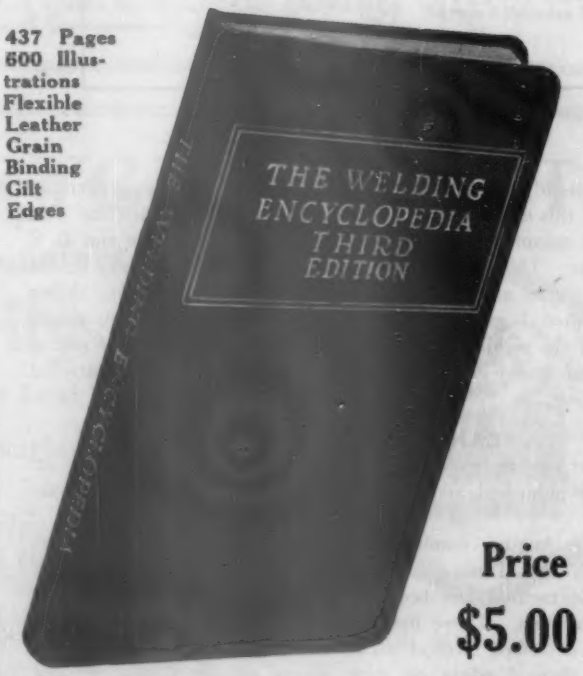
The editorial office of The Welding Engineer is recognized as the headquarters for authoritative information and help on all branches of welding, and conducts a large volume of correspondence helping welders and welding departments out of their difficulties. In a period of eight months it was found that 95% of the problems submitted to this office were answered directly from the pages of The Welding Encyclopedia.

Think of the time all these welders would have saved by providing themselves with a copy of The Welding Encyclopedia in advance! Don't wait until you get into trouble, or run up against a hard welding problem, but get the information in your hands now. Then, when you want it, it will be instantly available.

Whatever your troubles may be, you will find that The Welding Encyclopedia furnishes expert advice and instruction.

The table of contents below can give you only a very general idea of the scope of this work. Send for the book and give it a careful examination. We guarantee that it will be fully satisfactory and if not we will cheerfully make a refund. Send the coupon today.

437 Pages
600 Illustrations
Flexible Leather Grain Binding
Gilt Edges



Price $5.00

CONTENTS

1. Illustrated encyclopedia covering all words, terms and trade names used in welding.
2. Oxy-Acetylene Welding.—Aluminum, Steel, Cast Iron, Copper, Brass, Bronze. (Full instructions for welding each of these metals.)
3. Electric Arc Welding.—Complete instructions for welding all metals, studding, cutting, etc.
4. Electric Resistance Welding.—Includes Butt Welding, Line Welding, Percussion Welding and Spot Welding.
5. Thermit Welding.—The most complete treatise on this process ever published.
6. Boiler Welding.—An important subject for the welder to study.
7. Complete chapters on Pipe Welding, Rail Joint Welding and Tank Welding, explaining procedure in detail.
8. Heat Treatment of Steels.
9. Rules and Regulations.—What can be welded and what cannot be welded. Rules also govern the installation and operation of equipment.
10. Complete instruction courses in Oxy-Acetylene and Electric Arc Welding Lessons, Exercises, Reference Readings, Examinations.
11. Charts and Tables.—A fund of welding information at a glance. Includes color chart showing colors at various temperatures, and color chart showing proper adjustment of oxy-acetylene welding flame.
12. Condensed Catalogs.—Up-to-date information about the leading makes of welding apparatus and supplies. The Buyers' Index is a convenient and reliable guide to the man who purchases or recommends welding apparatus.

Welding Engineer Publishing Co.,
608 S. Dearborn St., Chicago, Ill.

Please send me a copy of The Welding Encyclopedia, Third Edition, for which find enclosed five dollars. I understand that I may keep it for five days for examination and if it is not satisfactory I may return it and you will refund the purchase price.

Name .....

Street .....

Postoffice .....

successful and was welded without preheating, a description of it may be of interest to some other welders. The fracture was a very unusual one and probably would not occur again in a long time, or come within the experience of other welders, but the method of handling the expansion and contraction problem may be successfully applied to similar jobs.

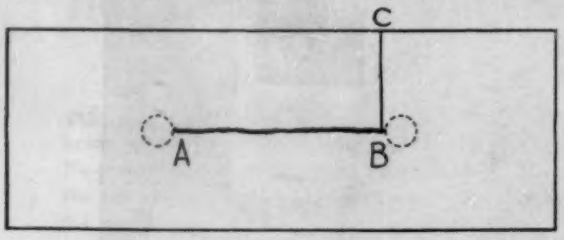


FIG 2

It will be apparent at once that to bevel out the fracture and weld it without making any provision for expansion would result in failure. Also, that local preheating might result in either distortion or the fracturing of some other portion of the pulley, so it was decided to cut the rim through from B to C as shown in Figure 2. After the cut was made I beveled out both the fracture A B and the cut B C, then started the weld at A. The result of applying heat at A was a displacement of the rim at C. This is

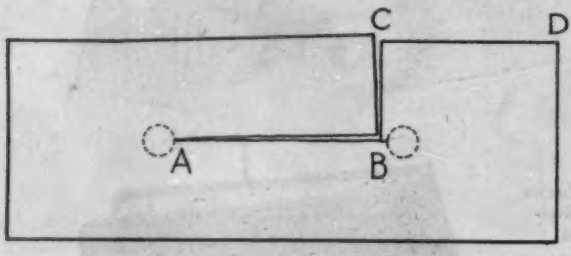


FIG.3

shown roughly in Figure 3. But as the welding progressed toward B this distortion became less noticeable, and when the weld A B was completed it was found that the edge of the rim D E was in line. Then the face of the pulley from B to F was heated with the torch, and the weld B C completed the repair. After it had cooled I used a portable grinder to grind off the rough surface of the weld. When the pulley was delivered to the owner he accepted it and expressed himself as being thoroughly satisfied with the job.

FLANGE WELDED TANKS

A correspondent makes the following interesting comment on a recently published article on the subject of welded tank construction:

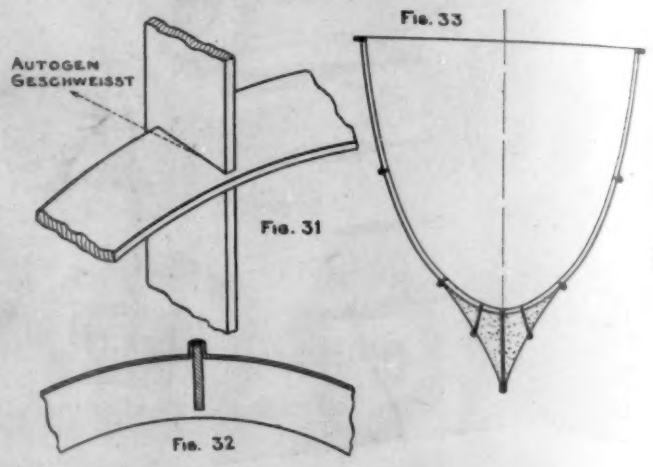
In your August number appears an interesting article on "Flange Welded Tanks." Acording to the first paragraph of the article, the method has been invented and developed by a Los Angeles concern. There may, of course, be particular features about the described method which might be new, but the method of using flanged edges on tank sheets and stiffeners, welded together at the edges, has been in practice for many years.

This form of construction was submitted to the Committee on Welding of Storage Tanks of the American Bureau of Welding, but as the flanging or bending of the edges on heavy sheets is impractical, and the investigation covered the construction and welding of large tanks, this particular design did not receive consideration.

A similar type of joint is shown on page 306 of the Welding Encyclopedia, Fig. 21 and Fig. 22, and in other publications. One of the earlier references to flange welded tanks is given by an Austrian engineer, Imm. Friedmann in 'Die konstruktive Anwendung der Autogenen Schweissung', published by A. Bagel, Dusseldorf, in the year 1911. The enclosed drawings Fig. 31, Fig. 32 and Fig. 33 are copied from this publication and give an idea of the design recommended by Mr. Friedmann, as will also the following translation of his description.

"Valuable is also the design applicable to the construction of cylindrical vessels shown by the perspective view Fig. 31 and cross section Fig. 32. A frame work consisting of upright and transverse steel ribs welded at intersections forms the support for the sheet steel shell.

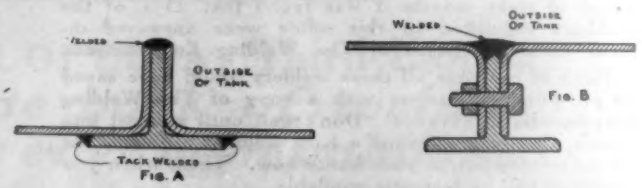
"The edges of the sheets are bent at an angle as shown in Fig. 32. The two edges of the upturned sheets and the edges of the



Details of Design Applicable to the Construction of Cylindrical Vessels

flat iron members are then welded together. This construction gives great rigidity with minimum weight in view of the stiffening effect of the ribs and lighter gauges of steel sheets may also be used.

"This construction is suited for water tanks, gas holders, condensation towers, etc., also for pontons and iron sheds as shown by Fig. 33."



"T" Iron Stiffeners.

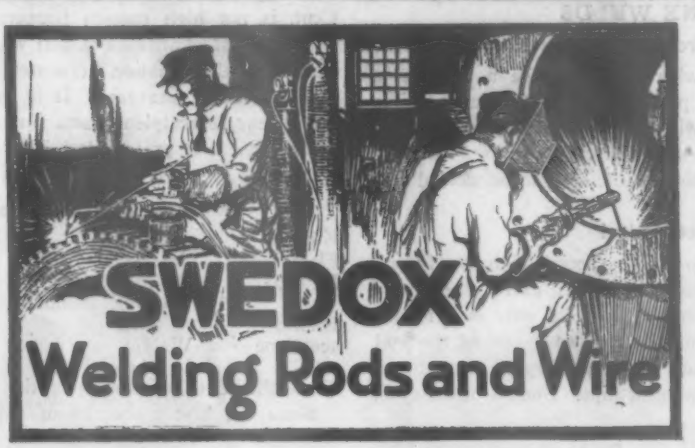
'T' iron stiffeners have been used in several ways, as may be seen from Fig. A and Fig. B. Fig. A shows the rib on the outside of the tank with the 'T' iron close to the inside of the shell and tack-welded. The design shown by Fig. B permits of flush outside welds and has some advantages when assembling the structure. The depth of the flanged edges may of course vary and has no bearing on the fundamental idea of the design.

STEEL TREATERS CONVENTION AT PITTSBURGH

The fifth annual convention of the American Society for Steel Treating was held in Pittsburgh during the week of October 8th to 12th. The growth of this society has been one of the outstanding developments in the history of the American technical organizations, and the occasion of the fifth annual convention was marked by a splendid list of exhibits, and an interesting program of papers ad discussions. Welding equipment was displayed and illustrated by the Air Reduction Sales Co., the General Electric Co., the Hauck Mfg. Co., and the Westinghouse Electric & Mfg. Co. A paper on the subject of "Metallography" and one on the "Testing of Oxy-Acetylene Welds" was read by J. R. Dawson, research metallurgist of the Union Carbon & Carbide Research Laboratories. An interesting paper on "Spark Testing of Steel" was presented by Don Stacks, the well known metallurgical engineer.

NONOX SWEDOX
LEKTROX SWEDOX
GAS CARBOX
ARC CARBOX

VANOX
NICKOX
KROMOX
RAILOX
CASTOX



SQUARE □ CASTOX
MANGANOX
ALUMINOX

BRONZOX
BRAZOX
TOBIN BRONZE
COPPER ALLOY RODS

COATED ELECTRODES

CASTOX-BRONZOX
ALUMINOX FLUXES.

SWEDOX welding wires and rods can be supplied immediately from stock, conforming in all respects to:

American Welding Society Specifications E No. 1-A; E No. 1-B; E No. 1-C; G No. 1-A; Folios No. 1-E and No. 1-G; and many others. We can furnish a welding wire or rod for any purpose and of any analysis required.

PUT YOUR WELDING TROUBLES UP TO US Let us prescribe the filler best adapted for your requirements. We maintain a research department conducted by experts for the benefit of our customers. This service is FREE OF CHARGE.

FLUXES—CASTOX, BRONZOX and ALUMINOX FLUXES when used with the corresponding non-ferrous filler rod will keep impurities out of the weld and promote thorough fusion.

FREE trial samples of any product will be furnished upon request. A trial of any SWEDOX product will convince you of its superiority. Send for these samples NOW.

CHICAGO, ILL.
127 N. Peoria St.

Central Steel & Wire Company

DETROIT, MICH.
Warren & Bellevue Aves.

HEYLANDT OXYGEN PLANTS

for producing oxygen by the air liquefaction process

99.2% Purity

during an eleven hour test

A satisfied customer is the best recommendation. One of our customers reports as follows:

"The plant continues to operate nicely, and it will be a pleasure for us to recommend this plant to any prospective customer you may have."

Every purchaser of Heylandt apparatus is a satisfied customer. You are invited to consult them for an opinion of their experience with it.

Some of the largest corporations in the United States, such as Armour & Co., Chicago, and the U. G. I. Contracting Company, of Philadelphia, use the Heylandt plant.

One 30-meter plant in stock in America, ready for immediate delivery.

Excellent service with repair parts. A Heylandt expert engineer always at your disposal. *For complete information write to*

Herman G. Amling

139 South 20th Avenue, Maywood, Ill.
Phone: Maywood 2048

Minneapolis Office: G. A. LEONARD, 2633 4th Street, S. E.

METALLOGRAPHY AND TESTING OF OXY-ACETYLENE WELDS

(Continued from page 22)

used to advantage and others where it would be a mistake to employ it. The use of the steel part, its composition, adaptability to heat treatment, the point at which welding is applied, etc., all have a bearing on the decision of suitability for welding. In many cases a rod of the same composition as the steel to be welded may be used to advantage.

High-Speed Steel

It is sometimes practicable to make special high-speed tools by the oxy-acetylene welding process. Where extra strength of tool is required or a type of tool that is used only occasionally is needed, a mild steel shank may be machined out at the end, a carborundum mold placed around it and high-speed steel rod of usual composition melted in by the blow pipe. Such a tool may be forged, quenched and tempered.

Fig. 9 shows the structure of the metal in a welded high-speed tool tip. Most of the carbide particles are quite small and widely distributed. The ground mass appears to be troostite. Traces of austenitic grain boundaries obtained in hardening still remain in the tempered tool.

Manganese Steel

So far as is generally known, welding of manganese steel has never been thoroughly investigated. The following photomicrographs will serve to give an idea of what occurs when welding is done. Fig. 10 shows the structure of weld metal obtained. It is made up of large grains of dendritic form. The structure shown in Fig. 11 is of the base metal ⅛ inch from the weld. The heating of the metal has caused marked grain growth to occur. Fig. 12 is of same location as Fig. 11, but at higher magnification. The grains are of martensitic appearance. Thin films of iron or manganese carbide can be seen between some of the grains. Fig. 13 shows the structure of the weld metal. Grains that appear to be martensite are surrounded by carbide films, and splotches of carbide are scattered throughout the section. Fig. 14 is of weld metal after heating to 1050 degrees Cent. and quenching in water. Carbides are absorbed, large grains have been broken up and much of dendritic structure removed.

The valuable properties of manganese steel are developed by quenching from a high temperature which produces an austenitic structure in which the grains should not be large. The austenitic manganese steel is easily converted to a martensitic condition. Relatively slight cold work as in the passage of locomotive and car wheels over a manganese steel frog will harden the stressed surface and not affect the remainder of the material. At the surface wears away new metal is stressed and hardened. The body of the metal then is strong and tough and wearing surface hard. It is also more susceptible to heat treatment than other steels. This is illustrated by the rapidity of grain growth, and the ease of formation of martensite and carbides.

Welds made in ⅛ inch thick manganese steel with manganese steel rods containing 1.25 per cent carbon and 13.00 per cent manganese, were tested by clamping in a vise and bending by hammering. The results recorded in Table IV were obtained.

These foregoing tests and photomicrographs indicate that where strength and resistance to shocks are required, the entire weld containing article of manganese steel should be heated to 1050 degrees Cent. and quenched in water. Evidently 1000 degrees Cent. is not high enough temperature for best results. Molten manganese steel absorbs carbon very readily and the elimination of carbides and formation of austenite become more difficult as the carbon content increases. It is the practice of many welders to use an excess acetylene flame for manganese steel welding, but the neutral flame is preferable. The analyses shown in Table V indicate the effect of welding on the composition of manganese steel.

Table IV

Bend Tests of Welded Manganese Steel

Test	Kind of Flame	Heat Treatment	Angle of Bend Before fracture
1	Excess Acetylene	As welded	Zero degrees
2	Neutral	As welded	25 degrees
3	Neutral	One-half hour at 1000 degrees Cent. Quenched in water at room temperature	75 degrees
4	Neutral	Same as 3. Then ½-hour at 1050 degrees Cent., again quench in water at room temperature	95 degrees

Table V

Manganese Steel Analyses

Kind of Flame	Material	Per Cent Carbon	Per Cent Manganese	Per Cent Silicon
Neutral	Welding rod	1.10	11.50	.08
	Weld metal obtained	1.00	9.60	.05
Excess acetylene	Welding rod	1.17	15.62	0.52
	Weld metal obtained	1.52	13.48	0.21

Since the best properties of manganese steel are not obtained with less than 11.00 per cent manganese the rod should contain not less than 13.00 per cent manganese to compensate for the 2 per cent that is lost during the welding operation.

The addition by welding of manganese steel to other steels is not satisfactory, for at the weld junction there is diffusion between the weld metal and the base metal and a gradient of manganese content from about 11 per cent to less than 1 per cent will be formed. Some of this junction zone will be weak and brittle, regardless of the treatment applied. For satisfactory results in welding manganese steel, the following should be kept in mind:

1. A neutral welding flame should be used.
2. Welding rod should contain at least 13.00 per cent manganese.
3. The entire welded part should be quenched from 1050 degrees Cent. in water, in cases where service requires high strength and resistance to shocks. Where service requires only compressive strength or resistance to wear, heat treatment is unnecessary.
4. Red hot manganese steel is very brittle and articles during welding should be supported in such a manner as to avoid setting up strains that might cause cracking.

Cast Iron

One of the important applications of oxy-acetylene welding is the repair of cast iron parts. The principal reasons for the wide use of this method are:

1. The joint obtained is of high quality.
2. The weld and adjoining metal are machinable.
3. The welding repair, in addition to costing much less than a new casting, is usually important because of the time saved. Frequently a weld can be made and the broken part placed in operation in a fraction of the time required to secure a new part. Many foundries are enabled to hold to high rate of production and efficiency of operation because of the aid of oxy-acetylene welding in reclaiming defective castings. This is a practice which should be highly recommended because quality of welded castings is satisfactory and the operation is without harmful effects.

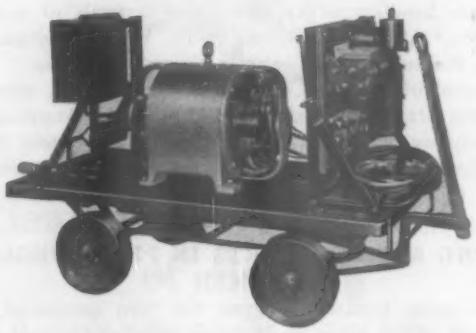
The macrograph shown in Fig. 15 is of a weld in gray iron. There are no blowholes or oxide films, and the weld metal is less coarse than the original metal. Transverse tests of numerous cast iron welds show that it is difficult to cause the break to pass through the weld, which proves that the weld is stronger than the original metal.

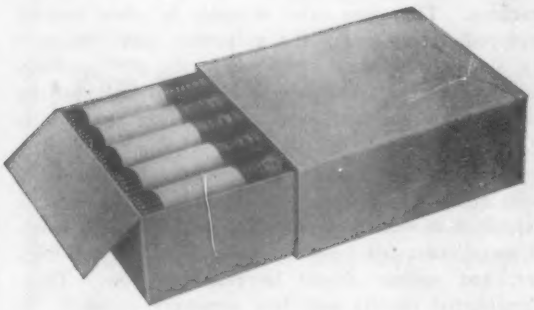
The reason for greater strength in the weld may be explained by reference to Figs. 16 and 17. The graphite in the original metal is in the form of large plates or flakes which weaken and embrittle the cast iron. The graphite in the weld is of smaller amount and in smaller plates more rounded in form. The weld also contains a greater proportion of pearlite. Fig 18 shows the weld metal structure in greater detail. It is made up of graphite, lamellar pearlite and ferrite, there being no free cementite.

The obtaining of good quality, machinable welds requires the use of knowledge gained perhaps in other phases of heat treatment. The hardness of carbon steels is profoundly affected by the rate

FOR ARC WELDING

Cast Iron
Malleable Iron
Steel
Brass
Bronze
Monel Metal





Specify

WILSON WELDERS and "Color-tipt" METALS

WILSON WELDER & METALS CO.

132 King Street, New York, N. Y.

Pittsburgh, Denver, Portland, Seattle, Detroit, Philadelphia, Los Angeles, Bartlesville, Okla., El Paso, Dallas, Birmingham, Baltimore, Chicago, Montreal, San Francisco, Spokane, Tacoma, Salt Lake City, New Orleans, Jacksonville

A steady preheating flame means gas economy in your cutting operations

TORCHWELD does it!

The specially designed TORCHWELD gas mixer assures a steady preheating flame because it thoroughly mixes the fuel gas and the oxygen away from the heat of the work. Fluctuation and consequent flashbacks are eliminated. There is no waste of gas or time.

Oxygen cutting gas passing through the torch does not meet with resistance. Correct delivery of pressure and volume assures fastest cutting and lowest gas cost.

TORCHWELD Torches are approved by the Underwriters' Laboratories.

Our new catalog, now ready for distribution, illustrates TORCHWELD welding and cutting torch construction, and tells how this construction increases efficiency. Send for your copy today.

For General Cutting Requirements
The Torchweld 15 MC
(One-piece tips)

Used in Structural Steel Plants, Railroad Shops, Boiler Shops, and for production cutting wherever a hand torch may be used. A wide range of service is offered because the one-price tips are obtainable in special lengths and special shapes for individual requirements.

For Extra Heavy Cutting
The Torchweld 25 MC
(Two-piece tips)

Used with Standard or Foundry Type tips of two-piece construction, for extra heavy cutting work or on dirty, rusty or scaly material, for cutting risers, billets, wrecking work, railroad work, steel mill work, etc.

TORCHWELD EQUIPMENT COMPANY

FULTON & CARPENTER STS. CHICAGO, ILL.

of cooling and the same is true of cast iron. Provision must be made for slow cooling. Burying in lime or sand is an aid. If the weld is small and the part welded large, heat will be conducted rapidly away from the weld and chilling will occur and some preheating is frequently necessary to avoid this rapid cooling.

An important factor of successful cast iron welding is the employment of correct preheating. Where the parts are free to expand, preheating is unnecessary. Welding of a broken lug is an example of repair in which preheating is not required. Where the weld is surrounded by metal the expansion due to local heating will cause cracking. The same rules as apply in other heating should be employed. Heat slowly and uniformly, make the weld and cool very slowly. In some cases where the part contains sections of widely different area, welding should be followed by a second heating to a uniform temperature before cooling is begun.

Other important considerations are the use of correct welding rod and suitable flux. The influence of the various elements of gray iron composition are fairly well understood. To avoid hardness of weld metal, cast iron welding rods should be of high silicon content, and suphur should be relatively low. Thus, graphite is precipitated rapidly and free cementite avoided. A proper flux combines with the slag, which is viscuous due to a high proportion of silicon oxide, and forms new slag that is thin, easily fusible, and readily floated to the surface of the weld. The cause of most blowholes in cast iron welds is the failure to float minute impurities to the surface. Careful microscopic examination will show that where blowholes are permitted to form, a slag particle is the root of the evil.

Brazing of cast iron with manganese or Tobin bronze is meeting with increased favor. The advantages of this method are:

1. The parts can be joined at lower temperature than is required for welding with cast iron rods. Therefore brazing requires lower temperature preheating.
2. The joint obtained is stronger than the cast iron.

The methods of preparing cast iron for brazing are similar to the preparation for welding. Flux is used to clean the surface and when the cast iron is heated to a dull red color the braze can be made and a good junction obtained.

Various Welding Applications

White iron also can be satisfactorily welded. Welding rods of white iron composition should be used. Because of the brittleness of white iron, and its greater shrinkage than gray iron, even greater preheating precautions are required for white iron than for gray iron.

In addition to the uses to which reference has been made, oxy-acetylene welding is successfully applied to the following metals: aluminum, copper, nickel and monel metal, and bronzes and brasses. Malleable iron should not be welded, but can be brazed successfully.

Conclusion

It has been the purpose of this paper to point out briefly some of the applications of welding and to emphasize the dependability of the process. A study of the rapid growth of welding and increase of its application leads one to the conclusion that the opportunities it offers for increased industrial efficiency are great.

A knowledge of metallurgy and heat treatment is necessary for proper understanding of the art, and members of this Society are especially fitted to appreciate the fundamentals of welding and its application to individual plants. It has been pointed out many times that actual loss results from failure to take advantage of the opportunities offered by this Society to aid in keeping pace with progress in heat treating knowledge and methods, and in the same way it is unquestionably true that present day industries can ill afford to neglect the savings offered by modern welding methods.

Although it is true that heat treaters might well make greater use of welding, to an even greater degree the welding industries are in need of the interest and advice that you gentlemen are able to give, on account of your knowledge of the action of metals under high temperatures.

The First Fall Meeting of A. W. S. Chicago Section

The first fall meeting of the American Welding Society, Chicago Section, was held at the rooms of the Western Society of Engineers, Chicago, on Friday, Oct. 5th. The meeting was well attended and resulted in securing several new memberships. The Directors of the section feel that the section has made a good start on its annual program.

Two interesting papers were presented. Mr. J. I. Banash, of The Oxweld Acetylene Company gave an interesting talk on the applications of the oxy-acetylene process, with special reference to the safe handling of apparatus and methods of getting the best results. Mr. A. F. Dillon, of Ft. Wayne, Indiana read a paper on the subject of Locomotive Frame Welding.

The Board of Directors, of the Chicago Section, were highly pleased that Mr. T. F. Barton, President of the American Welding Society was able to come to Chicago and attend this first fall meeting. Mr. Barton made an informal talk, outlining the plans of the American Welding Society for the coming year.

WELDING SOCIETY MEETS IN PITTSBURGH THIS MONTH

The following tentative program has been announced for the fall meeting of the American Welding Society to be held in Pittsburgh, October 24, 25 and 26. All sessions will start promptly as scheduled.

WEDNESDAY, OCTOBER 24, 1923

Morning

9:30 a. m. to 12. Opening Session Third Fall Meeting.

(a) Address of Welcome—J. D. Conway, Chairman, Pittsburgh Sect.

(b) General Statement of Society's Affairs—T. F. Barton, President, A. W. S.

(c) General Discussion of the Following Subjects—

1. General Interest in Section Meetings
2. Journal
3. Membership
4. Promotion of Welding

Afternoon

2:00 p. m. to 5. Industrial Application Session

(a) Report on the Industrial Applications of Welding and Its Possibilities

(b) General Relations of Society to the Industry—T. F. Barton, President, A. W. S.

(c) Technical Work of Society—C. A. Adams, Director, American Bureau of Welding

Evening

7:00 p. m. Fall Dinner of the American Welding Society

THURSDAY, OCTOBER 25th, 1923

Morning

9:00 a. m. to 11:00. Electric Arc Welding Committee, H. M. Hobart, Chairman.

9:30 a. m. to 11:00. Executive Committee, A. W. S.

11:00 a. m. to 12:30. Joint Session Board of Directors, A. W. S. and Executive Com. American Bureau of Welding.

Afternoon

2:00 p. m. Inspection Trip.

Evening

8:00 p. m. Meeting with Pittsburgh Railway Club.

FRIDAY, OCTOBER 26th, 1923

Morning

9:30 to 12:00. Gas Welding Committee, S. W. Miller, Chairman.

9:30 a. m. to 12. Joint Meeting Membership Committee and Vice-Presidents, American Welding Society.

Afternoon

2:00 p. m. to 5:00. Committee on Training of Operators, J. C. Wright, Chairman.

2:00 p. m. to 5:00. Inspection Trip.

8:00 p. m. Pittsburgh Section Meeting and American Welding Society. (Subject to be announced later).

Clean and Quick Method of Brazing

B. D. M. Co.'s No. 101 Gas Brazing Stand for tool rooms or manufacturing purposes, has two powerful gas blowpipes which are adjustable in any direction. The substantial iron frame carries also an air drum and necessary connections as illustrated. Equally effective for a small piece of soldering, or for a heavy job of brazing requiring both blowpipes and a built-up fire brick backing. Price $45.00. Catalog "G-X.," to be had for the asking, tells all about it.

Buffalo Dental Mfg. Co.
Buffalo, N. Y.

Federal Regulators Help SELL Your Torches

100% Efficient
Cheapest in the End

Improve Your Torches By Using "Federal" Regulators

"Ask for Catalog"

FEDERAL BRASS WORKS
3100 SOUTH KEDZIE AVENUE, CHICAGO

SUN-LITE

BRAND

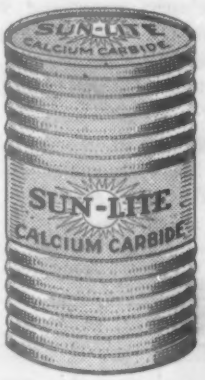
CALCIUM CARBIDE

Is made from best grade of coke and lime. Scientifically treated in an electric furnace so as to produce carbide of excellent quality and large gas yield.

For ACETYLENE GENERATORS

Sizes

3½x2
2x½
1¼x⅜
¼x1/12



Packed in non-returnable steel drums containing 100 lbs. net.

Manufactured by

Gas Tank Recharging Co.
Works: Keokuk, Iowa
General Office: - Milwaukee, Wis.

Distributed by

Big Three Welding & Equipment Co.
Oxy-Acetylene Equipment & Supplies
Fort Worth, Texas

SUN-LITE

NEWS OF THE WELDING TRADE

The Modern Engineering Company is making good use of illustrated letters in a direct advertising campaign, promoting the Meco Multi-Seat Gas Pressure Regulators. All pieces of literature featuring this item carry a cut-away view of the regulator, showing the various working parts.

As a result of a recent discussion at the convention of the Gas Products Association, the Bastian-Blessing Company are making the new REGO valves with the words "Use No Oil" forged on the body of the valve in raised letters. The opinion has been expressed that not enough attention is paid to the "Use No Oil" precaution, and that it should be made as prominent and emphatic as possible.

The District Sales Office has been opened recently by the Carbic Mfg. Company, at 605 Roberts Bldg., Los Angeles, California. C. J. Nyquist is in charge. Mr. Nyquist has been associated with the Home Office of the Carbic Company in Duluth, Minn., for the past two years.

Keeping pace with the industrial expansion of the South Atlantic states the Linde Air Products Company has recently started continuous operations in their newest oxygen producing plant, situated at Gwinnett street and Siles avenue, Savannah, Georgia. S. P. Wilson, Jr., is operating superintendent. An additional warehouse has also been opened at Charlotte, North Carolina, to serve customers in the Piedmont.

The autumn get-together luncheton of the Compressed Gas Manufacturers' Association is scheduled for Thursday, Oct. 18, at the Hotel Astor, New York City. One of the important subjects for discussion at this meeting is the program for the Eleventh Annual Meeting and Banquet, which is to be held next January.

After Chuck Phillips, of the Purox Company, had moved into his handsome new office at 620 E. Hancock street, Detroit, he found that he was located on a skip-stop street. Walking that extra block threatened to take so much of his extra time that he bought himself a new Dodge. Now he says he does not know how he would get along without it.

The Gibb Instrument Company, of Bay City, Michigan, manufacturers of Electric Welding Equipment, announce the appointment of Mr. H. A. Wilson as manager of their Detroit branch, vice Mr. F. M. Luchs, resigned. Mr. Wilson was formerly district manager in New York for A. P. Munning & Company.

W. M. Bastable, sales manager of the Wilson Welder & Metals Company, New York City, was in Chicago the first of the month, taking care of arrangements for fall business in the middle west.

C. J. Haines, formerly connected with the Electrox Company, Peoria, Illinois, has recently joined the staff of M. Keith Dunham, 110 S. Dearborn St., Chicago, selling liquefaction oxygen producing plants.

The Manual Arts High School, of Los Angeles, California, is starting a new course in Oxy-Acetylene Welding this fall. C. M. Anderson is in charge.

C. O. Epperson, of the Compressed Gas Corporation, of Denver, Colorado, made an extended trip, visiting the eastern offices of the Purox Company, this month. Last reports, he was starting to make the return trip from Chicago to Denver in a new Jewett.

The Portland Oxygen & Hydrogen Company, of Portland, Oregon, recently joined the Gas Products Association as an active member.

It is reported that a one-story addition is soon to be added to the plant of the Union Carbide Company, on Union Street, Niagara Falls, N. Y.

The Worcester, Massachusetts branch plant of the Thomson Electric Welding Company, of Lynn, Massachusetts, has recently been taken over by the Taylor-Hall Welding Corporation, of Worcester. The President and Treasurer of the new company are P. M. Hall and L. S. Taylor.

The plant of the New Bedford Welding and Machine Company, 1 Rodman Street, New Bedford, Massachusetts is now undergoing alterations and installation of new equipment to take care of new business.

John R. Brant, President of the Indiana Oxygen Company, Indianapolis, Indiana, has just returned from a long automobile trip through Northern Wisconsin. It is understood that this trip represents his annual attempt to escape from hay-fever.

The Page Steel and Wire Company, of Bridgeport, Connecticut, have recently perfected and put on the market a new welding metal for welding high carbon parts by either the oxy-acetylene or electric arc process. The carbon content of the new metal is practically 1%. Tests on deposits made with this metal on .42 carbon content steel indicate wearing qualities superior to that of the original metal.

A new welding shop called the West Douglas Welding and Boiler Works has been opened in Freeport, Illinois, by C. Regez. Repair welding and boiler repair work will be the main activities of the new concern.

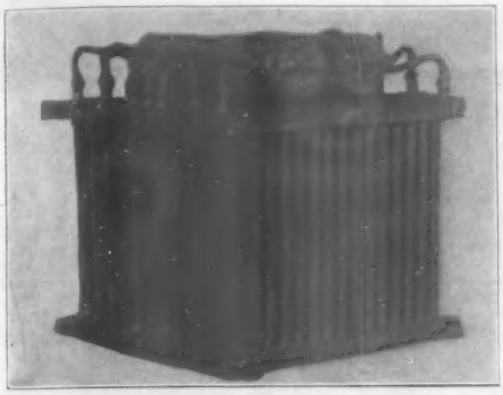
Willard Foster, President of the Tulsa Oxy-Hydro Company, was a visitor in Chicago during the week of Oct. 15th. It is reported that the purpose of this trip was to buy the best steer in the Chicago Stock Yards for the annual Fall barbecue at Tulsa.

CARTOON OF THE MONTH

"REGO" MILLS GOES HUNTING

710 WELDS ON STEAM BOILER

A remarkable example of accurate painstaking welding work shown in the accompanying photograph was recently undertaken and successfully completed by our R. E. Cook, of the Western Welders Co., 2543 Broadway, Oakland, Cal. There are 710 welds



710 Welds That Held.

in the construction. The boiler was tested at a cold water pressure of 2,000 lbs. and showed no leaks. The boiler contains a total of 364 separate seamless tubes, 182 of these are ¾ in. and 182 are ⅜ in. It is a combination water and fire tube boiler.

Prof. Thomson Tells Story of Resistance Welding

A graphic history of the development of resistance welding was presented in a more or less popular manner by Professor Elihu Thomson, director of the Thomson Research Laboratory,

Professor Elihu Thompson at His Desk in the Thompson Research Laboratory, General Electric Company, Lynn, Mass.

General Electric Company, Lynn, Mass., at a joint meeting, recently held in Schenectady, of the Northern New York section of the American Welding Society and the Schenectady branch of the American Society of Mechanical Engineers.

The first conception of the idea of electric welding came to Professor Thomson in 1877. The discovery was accidental and occasioned during the last lecture in a course of five on electricity at the Franklin Institute at Philadelphia. At that time he noticed that, on passing the condenser discharge through a fine wire of a spark coil of fair capacity, while the coarse wire primary coil had its ends closely placed together with a slight pressure, on the passage of the condenser discharge—which was three Leyden jars, a rather large discharge—what might be now called a "snap weld" was made and the ends of the wires so firmly joined that they had to be cut apart. The first actual machinery to perform welding operations was built in 1885, when the Thomson-Houston Electric Company, under Professor Thomson's direction, started to develop an alternating current system with dynamos and transformers. In 1886 the "Jews-harp" coil was developed, by means of which welds could be made between bars of different metals up to about three-quarters inches in diameter for iron and corresponding sizes, according to the heat required and the conductivity of the metal, for other materials than iron. It took 15 years to reach the process which is now so very commonly employed and which is very valuable; namely, spot welding, where two sheets of metal are laid one over the other and welded in spots by pressing the spots between heavy electrodes.

SPECIALLY WOUND GRINDER PROVES GREAT CONVENIENCE TO ELECTRIC WELDERS

There are so many welds which have to be ground to a smooth finish in order to make the repaired piece thoroughly serviceable, and so many cases where a smoothly finished job is necessary to please particular customers, that a portable grinder is practical and indispensible for the welding shop. Air driven grinders have been used to a large extent in the past because so many welding operations are carried on on the outside of the shop where no electric current has been available for the operator of electric grinding machines. In fact there are hundreds of portable welding outfits mounted on trucks doing duty in all parts of the country and carrying a heavy expensive air compressor as a part of the equipment.

A short time ago this matter was brought to the attention of Mr. Oscar P. Wodack, president of the Wodack Electrical Tool Corporation, of Chicago, and he volunteered to construct a special grinder for electric welders which would take the current directly from the welding generator. A grinder of this type especially wound to operate from a 80-volt circuit was made for the Mitchell Welding Corporation, of Chicago, and the purchasers expressed themselves as being thoroughly satisfied with the service given by it. The Wodack concern has therefore decided to give special attention to the manufacture of grinders for this type for use by shops which do electric welding.

The installation of a grinder of this type in cases where there is no shop circuit, and a gasoline driven welding generator is used, or in cases where the gasoline driven unit is sent out for the outside work, provides the necessary grinding facilities without the expense of heavy air pressure which has been necessary in the past.

A WELDING ROD HOLDER

For the Oxy-Acetylene Welder

If you are selling welders' supplies, keep a few welding rod holders in stock. There is a growing demand for this handy tool.

Write for Prices and Samples.

C. SORENSEN

18 E. 19th Street, Chicago, Ill.

HOLD-A-CAST FLUXES

1 lb. brazing
1 lb. cast iron
1 lb. aluminum
} $2.50 Per Set

Send for a set. Money back if not thoroughly satisfied.

Dealers wanted in all territories to handle Hold-A-Cast sets.

SELBORAL CO.

8 NORWICH ST., WORCESTER, MASS.

Finished Welds Build Profits—Do it With a WODACK

Finish your welds with a WODACK Portable Electric Grinder. A few minutes' time with this handy tool will make a different job. Your customers will be glad to pay more for the finished work. It's easy with a WODACK. You take it right to the job. Additional profits will soon pay for it. Your shop needs this tool.

But, be sure you get a WODACK. Write to

WODACK ELECTRIC TOOL CORPORATION, 43 S. Jefferson St., CHICAGO, ILL.

CURRENT WELDING LITERATURE

TORCHWELD CATALOGUE NO. 23—Issued by the Torchweld Equipment Company, Chicago. A four-page catalogue in loose-leaf form, printed on heavy enameled stock and bound with a handsome cover in three colors. As an introduction to the section devoted to welding torches, a full page illustration shows a sectional view of Torchweld construction, with a short discussion of several features of the torch. This is followed by a series of pages showing the special units, or outfits, made up for various welding requirements, and a series of illustrations and descriptions of the different models of welding torches, including the Machine Welding Torch. Following this is the Cutting Torch Section, illustrating the different features of the cutting torch construction with sectionals views, cutting units, or outfits, and individual descriptions of different types of cutting torches. Outfits containing both welding and cutting equipment are illustrated, followed by descriptions of brazing, light welding, lead burning and carbon burning tourches. The regulator section shows a sectional view of the regulator construction, which is followed by illustrated descriptions of various types of gas pressure regulators. In the accessories and supplies listed are Automatic and Hand Cutting Machines, Acetylene Generators, Manifolds, Carrying Cases, Tips, Goggles, Hoses, Welding Rods, Fluxes, etc. The new price list No. 37 applies to this catalogue and is printed to be included as a supplement. The book is an excellent piece of typography and illustration. The descriptions are complete and easy to read.

SOME REMARKS CONCERNING ADHESION—Three principal reasons are given for this defect in welding,—bad training—lack of control of the work, and the ease of getting adhesion instead of fusion. The author suggests an interesting experiment which will demonstrate the reason why adhesion is often secured—Revue De La Soudure Autogene, Paris, September.

WELDING CAST IRON—Pointing out that one of the most important points in making welds on cast iron is the influence of the weight of the casting and the distribution of this weight; the effect of these factors on expansion and contraction being very marked—Revue De La Soudure Autogene, Paris, September.

ELECTRIC WELDING FOR SAFE ENDING BOILER TUBES—The practice of using an electric Butt Welding Machine for safe ending locomotive boiler tubes is employed in their Union Pacific Shops, with results that show the practice to be thoroughly dependable and economical. The continuous operation of the plant including the preparation of the tube and safe ends, the safe ending, and the testing requires six men, and the average capacity of the plant is 400 flues a day. The welding speed of thirty seconds is possible. The welding is done by the resistance method—Railway Electrical Engineer, October.

THE OXY-ACETYLENE WELDING OF MILD STEELS, by D. Richardson,—The influence of impurities and the suitability of plates for welding purposes, the investigation under discussion showed that the selection of welding wire has considerable influence on the quality of the steel. This is also true of the selection of the material to be welded. The writer concludes that the high percentage of carbon is a disadvantage, that the percentage of silicon should be low, that the manganese is a useful element, that phosphorus had little effect, that sulphur appears to reduce the quality, that chromium, nickel and aluminum in small quantities are not harmful—Acetylene and Welding Journal, London, September.

OXY-ACETYLENE WELDING OF REFRIGERATING MACHINERY.—Abstract and paper read by Mr. C. Wilkie before the American Society of Refrigerator Engineers giving interesting details on the welding of small pipes, with particular reference to pipes used in artificial refrigeration—Acetylene and Welding Journal, London, September.

WELDING IN THE PETROLEUM INDUSTRY—Abstract and paper read before the American Welding Society, San Francisco Section describing the welding operations carried on in the plant of the Standard Oil Company, of California, with particular reference to the great variety of applications of the welding process in the laying of pipe lines and the construction and maintenance of the large oil refineries—Acetylene and Welding Journal, London, September.

AVOIDING TROUBLE IN USE OF OXY-ACETYLENE EQUIPMENT,—by H. Thompson. Practical points for welders regarding cylinders., acetylene generators, safety valves, regulators, gauges and torches,—Canadian Welding Journal, September.

JIG WELDING OPERATIONS REQUIRE SKILL AND ATTENTION—by J. L. Anderson. Each operator's jig should be adjusted to his own style and speed. Caution to avoid excessive clamping in the welding of thin sheets. Welds made under the influence of fusion and pressure have greater strength than hand welds of the same section or mechanical welds made by fusion only—Canadian Welding Journal, September.

PRODUCTION WELDING OF SHEET STEEL BY THE OXY-ACETYLENE PROCESS—by J. L. Anderson.—The problem of production welding is primarily one of design. The use of sheet metal for containers usually results in a product with a high safety factor. Welding operations can be carried on with small investment in equipment. Many of the applications of the process involve the simplest types of design. Jigs can be constructed so that the parts can be handled easily. The manufacturer has his choice between hand welding and machine welding, depending on the nature of the work.—Acetylene Journal, October.

WELDING AND CUTTING PRACTICE IN THE BOILER SHOP—Reclaiming cracked flanges—Welded Steel Boilers—Production of upright and horizontal boilers. Water Tank Fabrication—Materials used in tank and boiler work.—Wide application of the oxy-acetylene process to repair work—Marine Boiler Construction and Repair— Boiler Maker, August.

MAINTAINING OXY-ACETYLENE EQUIPMENT IN SERVICE.—Description of the construction and operation of a low pressure acetylene gas generator—Method of housing the generator and disposition of the sludge.—Acetylene Journal, October.

THE WELDING OF ALLOY STEELS—by C. J. Holslag.—The use of the alloy nickel electrode in arc welding will produce a marked increase in tensile strength. In tool steel welding, the metal must be kept perfectly fluid and molten, and is prevented from oxidyzing or spreading by being deposited in a trough built up around the welding area of some plastic and refractory material. Further protection is afforded by the use of a slag covering on the electrode. In welding leaf springs, the springs should be so clamped that each leaf bears its share of the load and retains its customary curvature while the weld is made. In all alloy welding done in automotive practice, the presence of nickel in the welding rod is very useful—Journal of the A. W. S.—September.

WELDING BLAST FURNACES ENGINE CYLINDERS,—by Z. T. Davis—Description of the procedure followed in welding a fractured 42" blast furnace engine cylinder head weighing 8½ tons. The cylinder head was cracked in six different places. Preheating was done entirely in temporary brick furnaces with charcoal fires,—Journal of the A. W. S. September.

NOTES ON SAFETY GLASS FOR IRON WELDERS,—by W. S. Enders,—A discussion of the effect of ultra-violet and infra-red radiations on the eye-ball. It appears that the only safe course is to provide safety glasses that are opaque to radiation at both ends of the spectrum.—Journal of the A. W. S. September.

WELDING CAST IRON WITH A SPECIAL NICKEL COPPER ALLOY WELDING WIRE,—by A. Churchward.—Cast iron welds have been successfully made by using a special wire containing 66 to 68% nickel, 1 to 2% manganese, .09% sulphur, 1 to 3% iron and 27 to 30% copper. This wire has certain operating peculiarities which make it necessary for the welder to get accustomed to it before securing the best results. It is recommended that it be deposited on a cold section and a bead no longer than 2" deposited at one time. When this bead is laid, it should be carefully peened, —Journal of the A. W. S. September.

A NEW FIELD FOR OXY-ACETYLENE WELDING, by T. C. Fetherstone.—Telling how the Oxy-acetylene process was used in the construction of the casings for two artesian wells.—Journal of the A. W. S. September.

RESISTANCE WELDING OF SHEET METAL, by H. W. Tobey, —Illustrations of some of the numerous application of resistance line welding to various forms of sheet metal—Journal of the A. W. S. September.

OXYGEN FROM THE AIR—Loose-leaf book issued by N. Keith Dunham, 110 S. Dearborn St., Chicago, Illinois. Describes and illustrates the plant used for producing oxygen from the air by the Oxeco Liquefaction Method. Thirty-eight 8½x11 in. pages, loose-leaf form, handsomely bound in a flexible keratol cover with gilded title plate. The introductory pages discuss in detail the industrial uses of oxygen, and methods of manufacturing and distribution of this gas. The text describes carefully the air liquefaction production process, with full page illustrations of all of the units in a production plant. To illustrate the air pressures, sectional views are used. Diagrams and floor plans give interesting information on the storage and distribution of oxygen gas, and the method of installing an oxygen producing plant. A four page folded insert in four colors shows a schematic sectional view of a plant producing oxygen gas from the air with explanations of each step in the production process. Following this treatise are illustrations of a number of views of typical oxygen producing plants installations. The book is handsomely printed and well arranged, and will be found to be complete in detail for those who seek information on the production of oxygen gas.

OXY-ACETYLENE TIPS—Monthly publication of the Linde Air Products Company. The October number contains the following stories: Huge Coal Dryer Oxy-acetylene Welded.—Production Welding on Cylinder Blocks—Discarded Boiler Tubing Used for Pipe Lines.—The Fastest Method for Cutting Cast Iron Pipe—Fabrication of Industrial Piping—One Day's Work in the Welding Shop of a Steel Mill.

WELDING, CUTTING AND BRAZING PRACTICE, by David Baxter—Learn to do difficult jobs by mastering simple ones—Welding of cracked cylinder head a simple operation, but should be given same attention as the more complicated ones.—American Garage and Auto Dealer, September.

AUTOGENOUS WELDING IN THE FIRE BOX.—A table compiled by the Bureau of Locomotive Inspection of the Interstate Commerce Commission lays the blame for many crown sheet failures on welding. It is recommended that steps be taken to make sure that whenever welding is done on boilers, it should be done in a manner that will satisfy the requirements of boiler practice.—Railway and Locomotive Engineering, September.

LOCOMOTIVE FRAME WELDING, by A. F. Dillon.—A practical discussion of ways and means to get the best results on frame repairs—Preparation of the job. The use of frame spreader to give expansion—The use of asbestos lagging to hold the heat—Necessity for using several men on heavy jobs so that they can be alternated.—Railway Purchases and Stores, September.

SMITH-O-GRAMS—Monthly publication of Smith's Inventions, Inc., September issue contains a short practical treatise on the welding of cast iron. This covers the preparation of the weld, the selection of the rod and flux, the adjustment of the flame, the welding operation, and the cooling process.

TORCHWELDING ON THE FARM, by David Baxter—Telling how the owner of a welding shop built up a good business by keeping a portable outfit available so that he could visit the farms and make repairs to broken farm machinery on the spot.—American Blacksmith, September.

ROL-MAN

WELDING RODS

ROL-MAN

For Gas Welding — For Electric Welding

Manganese 12.00 - 15.00% Carbon 1.00 - 1.45%

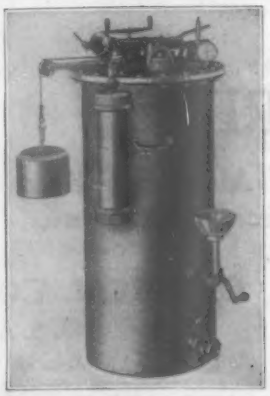
ROL-MAN MANGANESE STEEL for MAXIMUM WEAR

For TRACK WORK, MILLS, MINES, FURNACES, SMELTERS, CRUSHING, SCREENING & DREDGING PLANTS

A True High Manganese and High Carbon Product in Rolled Rods and Drawn Wire Presents Highest Abrasive Resistance and Maximum Wearing Qualities

Standard Sizes and Lengths Plain or Coated — Samples on Request

MANGANESE STEEL FORGE CO. — PHILADELPHIA, PA.



Superior Oxy-Acetylene Machine Company

Hamilton, Ohio, U. S. A.

Manufacturers of

WELDING AND CUTTING TORCHES, REGULATORS AND GAUGES,
SPECIAL BRASS PARTS, WELDING AND CUTTING OUTFITS,
CARBON BURNING AND LEAD BURNING OUTFITS, ELECTRIC DRILLS AND GRINDERS
CAST IRON—STEEL—BRASS AND ALUMINUM RODS, HOSE, FLUXES AND GOGGLES,

PEERLESS GENERATORS, as shown, are built in four sizes:

Carbide capacity	Cu. ft. of gas	Price
10-lb.	50 cu. ft.	$100.00
15-lb.	75 cu. ft.	110.00
20-lb.	100 cu. ft.	130.00
25-lb.	125 cu. ft.	150.00

(Allowance on acetylene tanks)

These Generators are PORTABLE, can be moved from one place to another, weighing about 135-lbs.

AUTOMATIC, equipped with the CELEBRATED SUPERIOR FEED.

GENERATES gas for about $1.20 per 100-cu. ft.

Batteries—Lead Molds—Post Builders—Lead Pots—Plate Burning Racks—Stencil Letters and Figures—Trucks—Preheaters.

Write for complete catalog.

We repair all makes of Torches, Regulators and Gauges.

SALLWELD

ASBESTOS PAPER

SAL-MO PRODUCTS Trade Mark

In rolls 36 inches wide weighing approximately 100 pounds each.

SLOWS UP COOLING PROCESS

No obnoxious or injurious fumes.

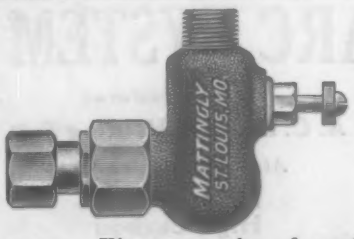
KEEPS DIRT OUT OF WELD.

Manufactured by

SALL MOUNTAIN COMPANY

140 So. Dearborn Street Chicago, Ill.

Eastern Office, Scranton, Pa.



Mattingly Safety Valves for Gas Welding & Cutting Equipment close instantly and automatically when the hose line fails from any cause. Fit any make of equipment. They protect your Welder, your Regulators, your Property, your Business and reduce your Liabilities. Are you thus protected? Ask for literature.

MATTINGLY AUTOMATIC VALVE CO.

714 N. 2nd St., St. Louis, Mo.

U. S. GAUGES

The difference between a gauge and a "U. S." gauge is the difference between a standard which may be lowered to fit a condition, and a standard which must be upheld to fulfill a reputation.

U. S. GAUGE CO.

44 Beaver St., New York

PRESSURE GAUGES — VACUUM GAUGES

For Gases Charged at High Pressures

WM. WHARTON, JR. & CO., INC.

30 Church St., New York, N. Y.

Machine that can be taken to the work. We will do immovable jobs anywhere in the world. Do you know any? Write for our plan to show you by actual performance.

ELECTRIC ARC CUTTING & WELDING CO.

152-158 Jelliff Ave. Phones, Waverly 7802-7803 Newark, N. J.

Welding Carbon Products

Columbia Round Welding Carbons
Columbia Welding Carbon Plates
Columbia Welding Carbon Paste
Columbia Welding Carbon Flour

Our welding carbon products are designed especially for welding operations

National Carbon Company, Inc.
Cleveland, Ohio San Francisco, Cal.

CAST IRON RODS
MADE FROM PIG IRON
(NO SCRAP USED)

Approximating
3.00%—in Silicon (Result: A soft weld)
.60%—in Phosphorus (Result: Fluidity)
.02%—in Sulphur (Result: A clean weld)

Our Rods the Best by Test. Also Rods, Wires and Fluxes for Welding All Other Metals

Prices on Application

Bierman-Everett Foundry Co.,
133-153 So. 20th St., Irvington, N. J.

OXYGEN
FOR CUTTING, WELDING, ETC.

Quick shipment and low prices on oxygen, hydrogen, cylinders, valves, Rego welding and cutting torches, regulators, welding wire, cast iron and aluminum rods, fluxes, plain and armored rubber hose, asbestos pads and paper, goggles, etc. All equipment fully guaranteed.

We are American pioneer manufacturers of oxygen. Write for catalog and prices.

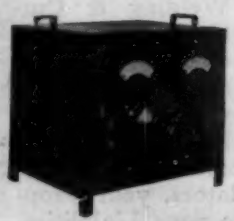
International Oxygen Company
Main Offices: NEWARK, N. J.
Branch Offices: New York, Pittsburgh, Toledo.

Specify—
"MOREY"

A Moisture Proof Aluminum Flux
Stable, Economical, Marvelous

MOREY FLUX & CHEMICAL CO.
Parkesburg, Penna. U. S. A.
Est. 1912 Inc. 1915

QUASI-ARC SYSTEM



We Manufacture:
A. C. & D. C. Welding Sets
Also Weldtrodes for
Mild Steel
High Carbon
Manganese
Cast Iron

L. W. 110 V. WELDER
Gives Machinable Weld

QUASI-ARC WELDTRODE CO., INC.
Peekskill, New York

Y TPEM6
½ H. P. MOTOR

Strand
Trade Mark
GRIND Those Welds
With
STRAND
Flexible Shaft Grinders
Thousands in Use
N. A. Strand Co.
CHICAGO
5001-5009 North Lincoln St.

Westinghouse
manufactures complete arc welding equipment for all welding and cutting purposes. Write for Leaflet 1826-B which describes this equipment in detail.
Westinghouse Electric & Manufacturing Co.
East Pittsburgh, Pa.

No. 511
Welder's Spectacle
Manufactured by
Chicago Eye Shield Co.
2300 Warren Ave. Chicago

IMPERIAL WELDING AND CUTTING EQUIPMENT
OXY-ACETYLENE PROCESS

A new mixing principle, a regulator that accurately controls gases, the greatest working range ever covered by ONE torch —are exclusive IMPERIAL features. Write for catalog.
Imperial Brass Mfg. Co., 817 S. Racine Ave., Chicago

DAVIS-BOURNONVILLE COMPANY
was merged with
AIR REDUCTION SALES COMPANY
on March 17, 1922

The Oxyacetylene Welding and Cutting products formerly manufactured by Davis-Bournonville Co. are now made and sold by Air Reduction Sales Co. under the trade name of "Airco-Davis-Bournonville" or "Airco-D-B."

(See advertisement of Air Reduction Sales Co.)

Carbic

Let Them Tell You

We believe that occasionally it's good to let our customers and our prospectives know what the other fellow thinks of the Carbic system, for somehow when "they" say it, it sounds different.

The statements below are all guaranteed to be exact copies of expressions received recently from Carbic users.

Paper company in Maine:
"We are in receipt of your letter of the 27th and would say we have advised Mr.——of our satisfaction regarding Carbic generator and welding torch which is in use here. The men in our——mill are very much pleased with it."

Machine shop in Massachusetts:
"Speaking of your Carbic Generator we would say that we are very much satisfied with the way it works.
In figuring out our costs for our welding department, we find that our cost of acetylene has actually been reduced approximately 40%.
We find also that the torches are a very handy tool and work perfectly. In fact, we are so well satisfied with the entire outfit, that now, we are thinking of installing a second one in the very near future."

Saw mill in Texas:
"We consider the Carbic welding and cutting outfit a good investment for a saw mill to make and we are glad we bought one."

Knitting Mill in East:
"We find that the price per cubic foot with your Carbic is much lower than with compressed acetylene. In all, we are very well satisfied with this outfit, and our welder has nothing but the highest paise for Carbic."

Coal company in Illinois:
"We have three of these Generators in operation and the convenience of your generators is considered a big factor. It is so extremely portable that it can be taken to any part of our operations with extreme ease.
Your Carbic cakes are also giving excellent satisfaction and we find them most convenient and practical."

Steel company in Rhode Island:
"The generator purchased from you about six months ago has been working so smoothly and with such an absence of trouble, that we have almost forgotten we have it.
It is satisfactory in every way.

Million dollar copper mining company in New Mexico:
"The Acetylene Generator you furnished us on trial on the above order has proven satisfactory and we are very glad indeed, to take same. Will you, therefore, send us invoices for same.?"

Welder in upper New York State:
"I am having wonderful success with the Carbic low pressure generator and agents from other houses admit it is the best little generator they have seen."

There are hundreds of other Carbic boosters in every section of the country.

Safe, portable acetylene at a lower cost—that's the Carbic System.

Carbic Manufacturing Company

NEW YORK 141 Centre Street	DULUTH General Office and Factory	CHICAGO 565 W. Washington Blvd.
BOSTON 27 School St.	ATLANTA, GA. 169 Haynes St.	CHARLOTTE, N. C. W. 9th St. & So. Ry.
KANSAS CITY, MO. 1411 St. Louis Ave.	EL PASO, TEXAS 412 Myrtle Ave.	DENVER, COLO. Hendrie & Bolthoff M. & S. CO.
NEW ORLEANS, LA. Woodward, Wight & Co.	DALLAS, TEXAS Brigge-Weaver Machinery Co.	LOS ANGELES, CAL. 606 Robert Bldg.

Warehouses and Representatives in other Principal Cities.

Carbic Cakes save money, time and patience, and yield a purer gas

Trade **Carbolite** Mark

A ONE BRAND, HIGHEST QUALITY

CALCIUM CARBIDE

The trade name Carbolite has represented our product continuously for many years. Its appearance on each package is a guarantee of its excellence and a protection to our customers.

Carbolite is carefully manufactured from best grade raw materials insuring at all times a superior quality, both in purity and gas yield. Our modern screening and inspection system also makes certain a thoroughly clean product, uniform in size.

Carbolite is made in all standard sizes and can be supplied promptly from warehouse stocks.

Packed only in Yellow Containers

American Carbolite Sales Company

General Offices

DULUTH, MINN.

WAREHOUSES IN ALL CENTRAL STATES